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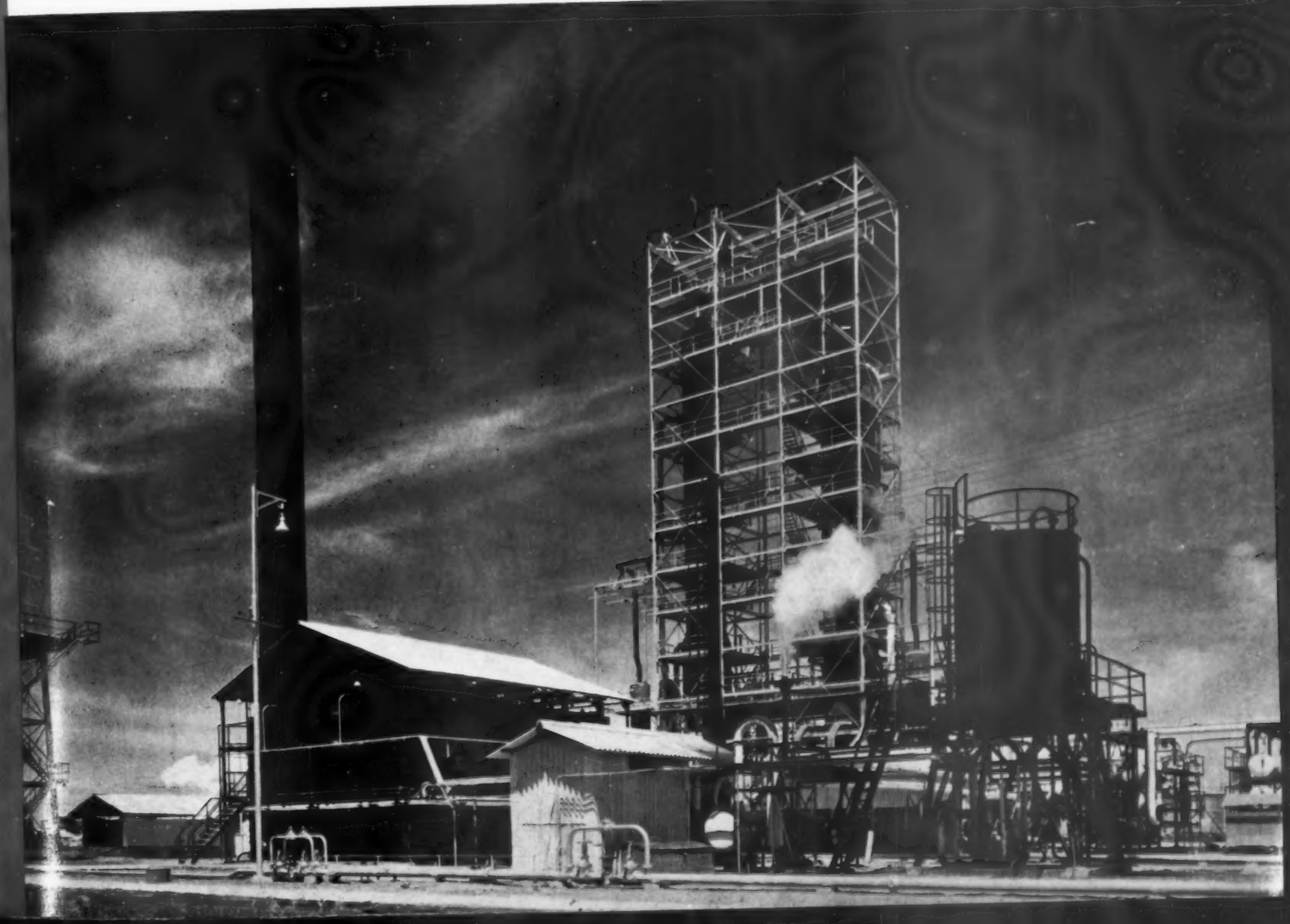

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EDITORIAL

ILLINOIS PRESSURE ON CRUDE MARKET ABATING

WITH the rapid upsurge of oil production in Illinois fields that state has become more than ever a center of interest for the whole United States oil industry.

In successive steps its daily output has risen until by mid-March the average daily output reached 455,000 bbl. and Illinois displaced Oklahoma as the third producing state of the country.

Certainly a state proration law would be helpful in preventing waste in production and marketing. There is reason to believe that the state will have a model proration law within a year or two, very likely after the acute need for it has passed. But amidst the clamour for state regulation, it should be borne in mind that even a model law would not entirely relieve the pressure of Illinois crude on the nation's markets, nor would such a law prevent the displacement of a certain amount of oil from markets heretofore served by the Mid-Continent. Such wasteful practices as exist are to be found mainly around Salem where the field is of the town lot variety, at least in the northern part, and no more wasteful practices are to be found there than in any new town lot field. Even though there were a state conservation law which included well spacing requirements, it has been found elsewhere that the courts will almost invariably permit the drilling of at least one well on a lot, no matter how small, if there is evidence that adjoining owners will not combine to form a unitized block—under the circumstances that prevail at Salem, a very difficult form of agreement. It is safe to assume that there would be but little difference in the total output or in the production methods during these first few years of flush production even if an adequate state law had been in force.

The present high rate of production is not the only reason for the disturbance that Illinois oil has caused. Lying in the heart of the great central refining and distributing region it has enjoyed an important marketing advantage. Because of the short haul to Chicago, St. Louis and the refining centers of Ohio and Kentucky, oil from Illinois was bound to displace crude from Kansas, Oklahoma and New Mexico. More recently a new factor has injected itself into the situation: high tanker rates arising indirectly from the war in Europe, have given Illinois an opening in the markets of the Eastern seaboard and oil from the new fields is reaching refineries on the coast thereby displacing a limited amount of Texas and Louisiana crude which formerly was shipped by tanker from the Gulf Coast.

However, where natural advantages were not enough to win new markets, producers that lacked pipeline or refinery connections have undercut prices. It is difficult to determine how much Illinois oil is being sold below the posted prices but estimates have been made that place the figure as high as 20 percent. This under selling and consequent loss of revenue is a serious matter for the state. Even the posted price of $1.05, on the basis of Mid-Continent prices plus pipeline tariff is 15 to 20 cents too low. Producers are sacrificing perhaps as much as $150,000 per day in revenue and royalty holders may be losing $20,000 per day.

While some concern has been expressed over the effect that increasing production from Illinois may have on the crude price structure, there are enough constructive factors in sight to furnish reasonable assurance on this point. Those familiar with the market seem to feel that up to 525,000 bbl. per day of Illinois crude can be absorbed without serious dislocation. Investigation reveals that less and less crude is going at lower than posted prices, and crude that is bringing but 85 cents per barrel now was contracted for previously. It would be difficult if not impossible to get any quantity of Illinois crude at that price at present.

Perhaps the most reassuring feature in the Illinois situation is the will to voluntary curtailment and approved production practice in fields where this is possible. Almost from the first a repressuring program was carried on in the Louden field and a certain amount of repressuring is being done in the south part of the Salem field.

MEXICO'S OIL INDUSTRY Two Years After Expropriation

Continued Operation Even on Reduced Scale Heralded as a Victory by Government Spokesman - "Boycott" by Expelled Companies Held Responsible for Failure to Regain Export Markets and Maintain Equipment.

In order to show the actual condition of the Mexican oil industry two years after expropriation, which took place by decree March 18, 1938, WORLD PETROLEUM presents the accompanying article. This is intended purely as a factual account and has nothing to do with the legal or moral aspect of the confiscation. Statements of officials in charge of petroleum operations are given as well as an account of protests and criticisms from oil workers and consumers. Mexico has been able to keep the industry going, but at a heavy price. Financially, expropriation has been an unprofitable experiment. Money must now be found to drill wells, provide transport and repair refineries. With Nazi Germany shut off the attempt to find export markets grows more difficult. Operation of Mexican oil properties under confiscation cannot yet be labeled a success or failure, but the burden, direct and indirect, appears to grow heavier as time goes on.

TWO YEARS after Mexico's expropriation of foreign owned oil properties the official claim is that the government directed petroleum industry is making as good progress as could be expected. It is admitted that many difficulties have been encountered, that the country has not been able to replace the export markets which it lost when the private companies were driven out and that it has been impossible to satisfy the demands put forward by the workers in the strike that led up to the act of expropriation or even to maintain some of the special benefits that they enjoyed under the regime of private ownership.

In the speeches and public statements made from time to time by those closely associated with the Cardenas administration most of these difficulties are laid at the door of the expelled companies. It is alleged that they have instituted a boycott against Mexican oil and have used their influence to prevent Mexico from obtaining needed drilling, refining and transport equipment. Apparently the official view is that the companies should have joined in making a success of an act which they have continuously denounced as one of robbery and spoilation.

On the other hand it is pointed out with considerable pride that predictions of economic collapse under Mexican management have not been realized. Figures are quoted to show that while production and exports dropped off 10,000,000 bbl. in the year following expropriation half this loss has been regained during the past twelve months. Plans for the expansion of drilling, the improvement of refineries, the extension of pipelines and the purchase of tankers are displayed. The claim is made that by the end of the year Mexico will be exporting 2,000,000 bbl. of oil monthly or practically at the same rate as in the period preceding confiscation. While acknowledging that the government has suffered a heavy loss in revenue from the expulsion of the oil companies and that its resources are badly strained it is predicted that all obstacles will be overcome and that in another twelve months the oil industry will be on a solid footing with exports and revenues restored to the level they had reached before the seizure of company properties.

"Production has now attained a potentiality of 176,000 bbl. daily", said Ing. Vicente Cortes Herrera, managing director of Petroleos Mexicanos (Pemex), in a special interview. "Not all this amount is being drawn upon, but the effective potentiality of the Mexican industry can be estimated from the figures cited.

"The government company now controls the production of some 1,000 wells. Those in the Poza Rica zone, which number about 40, can alone produce more than 115,000 bbl. daily. The unitary cost of the foreign companies before March 1938 was approximately 1.32 pesos per bbl. of 159 liters. With expropriation this cost increased to 1.60 pesos during the first year. This increase could not be avoided because the economic blockade against our exports forced the closing of part of the wells or reduction of the quotas allowed those in production. By the end of 1939 the production cost was 1.35 pesos. If there were outlets for the total production of Mexican fields the cost would be only 69 centavos.

"Owing to the obstacles raised by the expropriated companies it was only with the greatest difficulty that Mexico could acquire or manufacture spare parts for the refineries, pipelines, cargo terminals and other facilities taken over. With the exception of those in the Poza Rica district these were in a deplorably run down condition. That was why the companies in recent years had to resort to the use of tetraethyl lead to improve the octanage of the low quality gasoline they produced. Naturally Mexico could not hope immediately to attain results superior to those of the former managements.

"Since the influence of the expropriated companies prevented us from obtaining in the United States the machinery and equipment so badly needed we were compelled to open relations with European manufacturers who have no motive for denying a customer what he asks. The business, begun on a small scale and undertaken not only because of the attitude of American manufacturers but also because of better terms in the way of prices, deliveries and settlements, has assumed considerable proportions. The undoubted harm which it has done to the commerce of the United States can be blamed on the oil companies.

"More recently it became possible for us to deal with American concerns so that now we have begun the repair and reconditioning of refineries through contracts with Howes & Whittaker of California and Winkler Koch of Wichita, Kansas.

"Since expropriation geological and geophysical explorations have established the desirability of further test drilling. This drilling campaign is under way and its results will prove the capacity or deficiency of Mexican technicians in this field.

"In summing up the situation it can be said that the Mexican oil industry, far from being in the terrible state represented in

interested quarters, is developing normally and overcoming all obstacles in its path. Within two years it has been demonstrated not only that it can be managed by Mexicans but that its products are more than sufficient to indemnify the foreign companies for the value of their properties."

As part of the program of refining improvement referred to, PEMEX announces that it has arranged to install three large boilers in the refinery at Minatitlan, Vera Cruz, one of the largest operated by Mexican Eagle, and that it is preparing to improve the Arbol Grande refinery, near Tampico, with the provision of a solvents plant that is expected greatly to improve the company's lubricants and to enlarge this refinery so that its present daily capacity of 7,000 bbl. will be doubled. The Arbol Grande work contemplates an investment of 8,000,000 pesos (some $1,333,350) of which 5,000,000 pesos will be spent for the solvents plant and the rest for general improvements. PEMEX asserts that all material for the Arbol Grande job will be obtained in the United States, presumably under the contracts referred to by Ing. Cortes Herrera.

The greatest immediate problem confronting PEMEX, according to its representatives, is an insufficiency of delivery facilities. The company hopes to remedy this with the fleet of ten 10,000-ton tankers it has acquired at a reported cash price of $600,000 each. Two of these vessels, the CERRO AZUL and the TAMPICO are now in service and delivery of the others is expected to be taken by the end of summer. These craft are in addition to the fleet that is being built in Italy in exchange for oil and its products. The Italian tankers are looked for during the summer. PEMEX is supplying a large region of western Mexico with oil and products by the roundabout and apparently costly procedure of sending government steamers through the Panama Canal, some 7,000 miles for a 1,500 to 2,000-mile haul.

Need for this long distance shipping results from an acute shortage of railroad tank cars. In petitioning PEMEX to remedy this situation, the Confederation of Chambers of Commerce and Industry asserted that this paucity is making precarious much business in several sections of Mexico. The Confederation asserted that the normal average daily movement of tank cars from Tampico should be 81 but that it is now only 60, that the National Railways, Mexico's greatest railroad, needs at least 1,215 tank cars for normal industrial distribution and that the Southern Pacific Railway of Mexico, serving a large part of the Pacific coast, requires 55 more tank cars than it is operating. The National, the Confederation said, was able to rent 200 American tankers last year, but it has been obliged to return 100 of them. The National has been run by its workers for the past two years. Its management admits that lack of funds prevents it from meeting the demands made upon it. The Southern is in a bad way. Its stockholders are to decide at their annual meeting in New York early in April whether to abandon the line or offer it for sale to the Mexican government.

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Lazaro Cardenas, President of Mexico.

Complaints by motorists that gasoline now marketed in Mexico is bad prompted Distribuidora de Petroleos Mexicanos, the official oil and products sales company, to issue a statement declaring that the gas is very good as, according to certification, it is 60-octane, three better than that which the expropriated firms marketed. Distribuidora said that it is sending samples of all gasoline produced in Mexico to foreign laboratories from time to time for analysis.

In discussing government retailing of gasoline, EL MUNDO, important Tampico daily, reports:

"The Ministry of the Interior has recommended to Petroleos Mexicanos that the managers of gasoline stations along the national highways treat tourists with more consideration as there are numerous complaints that they sell poor gasoline, pay little attention to automobilists and that they are not as courteous as might be desired. We are glad that it was the Ministry that made this recommendation and complaint. If the press had made it they would be accusing us of treason to the nation and of being in the pay of the oil companies."

Government oil and products distributors are doing well with the distribution of natural gas from the Gulf fields in containers in Mexico City and some adjacent communities. They are advancing plans for building a gas line 150 miles long from Poza Rica to the Federal District and constructing a pipeline, 303 kilometers long, from the southern Vera Cruz fields across the Isthmus of Tehuantepec to Salina Cruz which the federal government proposes to recondition as the leading port of southwestern Mexico, a job which will include a base at the port for bunker and general oil distribution to the Mexican west and the Orient.

Production and exports have held up since expropriation better than many observers expected. PEMEX and other government oil institutions do not issue regular official statistics but unofficial figures which have met with no denial or criticism in government quarters place 1939 production at around 42,500,000 bbl., comparing with some 38,200,000 in 1938 and 46,689,694 in 1937. Of last year's production, about 4,800,000 bbl. came from wells owned directly by the government; some 1,900,000 from enterprises not affected by expropriation, and the rest from wells of the expropriated companies. Table I accompanying gives figures of production for the past three years while Table II shows exports by principal countries.

Production, declared Lic. Eduardo Suarez, Minister of Finance, in a recent statement, is soon to be increased to at least 220,000 bbl. daily of which 160,000 will be devoted to the home market, leaving 60,000 for export. Minister Suarez declared there is a great demand for all Mexican products, particularly oil and industrial metals and minerals, on foreign markets. He announced, without giving details, that about $900,000 (U. S.) worth of oil had been sold abroad in February and asserted that there is little danger of embargoes of tankers carrying Mexican oil as four foreign courts had ruled favorably toward Mexico in this regard. He reported that $600,000 is being spent for drilling equipment, that 11 wells, with a minimum daily production of 5,000 bbl. each, are being drilled and that the drilling of nine more starts in June. The government, he said, is building a 12-inch pipeline 150 kilometers in length between Poza Rica and Alamo to facilitate direct supplies of oil for sea deliveries.

Mexican technicians, Minister Suarez stated, are working to perfect a process for increasing gasoline octanage and the government is arranging for the early installation of a high grade gasoline plant. Since expropriation, Mexico has had to import, largely from the United States, airplane gasoline. A recent presidential decree made these imports duty free. However, said the Minister, a government plant at Tacuba, a Mexico City suburb, has begun production of tetraethyl lead. Gasoline that is expected to result from these endeavors will be of two classes of octanage, one of from 59 to 65, the other from 75 to 80. In connection with the project of producing higher test gasoline it is noteworthy that Mexico recently voided the patents of Ethyl Gasoline Corporation, thus paving the way for the use of this process without remuneration to the owners.

Exports last year, according to the best information obtainable were approximately 19,000,000 bbl., including bunkers and 480,000 bbl. of asphalt. Sales last year were chiefly to Germany, 6,300,000 bbl.; the United States 5,400,000; Italy, 4,800,000, and Scandinavia, 400,000. An interesting development in 1939 exports was a cash deal with Japan in October for 320,000 bbl. at the reported price of 90 cents (U. S.) the barrel. This transaction was handled by the Laguna Oil Co., a Japanese firm. All this oil is Poza Rica crude. In 1939 there were two shipments under this contract, each of 87,000 bbl., one in November, the other in December. During February, some 85,000 bbl. were shipped on this deal.

Mexico is looking hopefully to Japan to replace the lost German market and certain Japanese interests are displaying an active interest in acquiring Mexican production. A case in point is the completion of the program of the Japanese-owned Cia. Petrolera Veracruzana, S. A., to drill 30 wells to provide oil for Japan. Japanese recently got control of this company, a small independent not affected by expropriation, and increased its capital. The company has been shipping small amounts of oil to Asia. Now it seems it intends to do this business on a larger scale.

Vercruzana has contracted with the Laguna to buy and market the entire output of the wells it is to start drilling soon. The wells are to be in proven fields just south of Panuco, near the Tamesi river. The company announces it has obtained Mexican government approval of its plans and that it is to give the government an unspecified share in the output.

There are also hints that the Nipponese have other projects in view. It has been reported that PEMEX was negotiating with a foreign enterprise to swap oil for the pipe it needs for the gas line to be built between Poza Rica and the Federal District. This enterprise, it is believed, is Japanese. There is deep official silence about this reported deal and it cannot be ascertained now whether or not it has been consummated.

Japanese interest is also rumored in the Tehuantepec pipeline. But as yet nothing concrete can be gathered about this. The government announcement of plans for this project said that oil from its distribution base at Salina Cruz would be shipped to the Orient. An official of the Kawaasaki Co. of Tokyo has announced that Japanese capitalists are disposed to make considerable investments in this pipeline and to increase Mexican oil production.

How great the change that has taken place in Mexico's oil exports is indicated by the fact that while prior to 1938 two-thirds of all shipments went to the United States, United Kingdom and Netherlands West Indies the two latter had disappeared entirely as markets for Mexican oil by 1939 while of the shipments to the United States in the latter year nearly 70 percent was introduced in bond for reexport. Mexico's exports to other Latin American countries have shrunk to a third of their former size. Of the reduced volume of shipments abroad in 1939 approximately half went to Germany and Italy despite the fact that exports to Germany ceased at the end of August because of the allied blockade. At the present time Mexico's hope of maintaining a substantial volume of exports seems to depend mainly on Italy and Japan.

An equally sharp change has taken place in the character of exports. Before expropriation 72 percent of the total consisted of manufactured products. In 1939 these products constituted only 36 percent of the reduced total, nearly two-thirds of the shipments abroad consisting of crude.

Statements from Mexican official quarters, especially when these are to be published outside the country, naturally may be expected to put the best possible face on the internal situation in the oil industry. Nevertheless there have been a number of developments during the past several months which reveal that the going has been far from smooth and that dissatisfaction has cropped up in many quarters. One of these was the confidential report of Ing. Cortes Herrera several months ago which complained of laxity, inefficiency and dishonesty among workers and managers.

The report pointed out that between April and July 1938, directly following the seizure of the oil properties, the number of employees increased 1920 or 13.4 percent and expenses rose from 4,273,218 pesos to 5,016,701 pesos monthly or nearly 18 percent. At the same time production fell off from 570,000 to 420,000 cubic meters or 26 percent and refinery throughput declined from 18,000 to 13,100 cubic meters daily or 27 percent. It was stated that the administration was unable to stem this rise in expenditures because local administrative boards exercised the prerogative of managing their affairs and hiring additional hands.

Numerous cases of thefts of oil from pipelines, of stores from plants and of defalcations by local managers were cited in the report which stated that the operatives in local areas appeared to look upon the property taken from the oil companies as their own and in various instances refused to allow equipment to be moved from one location to another where it was needed because of unwillingness to let it pass from their control.

Publication of this report percipitated a lively row. It brought replies from local unions to the effect that a main cause of increased expense was the payment of excessive salaries to higher officials and charged that operating deficiencies were due largely to the appointment to important position of men who knew nothing of the industry. Local 22 of Tampico pointed out that in their own district, the Agua Dulce zone, production increased whenever the engineers in charge were not on the job.

Demands of the union included the dismissal of officers receiving what they designated as exorbitant salaries and the discharge of workers engaged since expropriation. The number of these, according to a statement by the oil workers' national union, was 2,593. Another complaint was that although the court decree in the labor case against the oil companies provided a daily wage of 5.41 pesos for workers in the Tampico zone they continued to receive only 4.87 pesos from which big cuts were taken for union fees, saving funds and other charges, leaving only about 20 pesos (at current value $3.34) per week.

TABLE I

MEXICAN OIL PRODUCTION

(In thousands of bbl.)

Fields	1937	1938	1939
Poza Rica	18.634	22.021	26.072
Northern	9.806	5.344	5.586
Southern	8.292	4.230	4.652
Isthmus	9.958	6.684	6.247
	46.690	38.279	42.479

Many specific instances are related of per-

sons with position and pay far out of line with what the ordinary worker considers reasonable. Typical cases are those of a former welder receiving 11 pesos per day who now draws 60 pesos daily as a manager of refinery personnel, of a stenographer whose top pay was no more than 250 pesos a month when working for a private company who now occupies an executive position paying 1,200 pesos per month, of a mechanic who jumped from 10.75 pesos daily to 70 pesos, and of various officials occupying two or more positions and drawing salaries up to 2,200 pesos monthly for each. It is understandable that when a business as large as that of the international oil companies was taken over bodily under government direction those with a political or labor union pull should have moved in to occupy the more lucrative jobs and that many of these are more interested in advancing their own salaries than in trying to build up an industry of which they know little or nothing.

The most convincing evidence of discord and difficulty, however, was the fact that President Cardenas himself felt it necessary to take a hand in the situation. This he did through a conference with 96 representatives of the oil workers union held in the National Palace. At this meeting, held early in March, the President chided groups within the industry for their attitude "which," he said, "seems to be similar to the struggle formerly maintained against the companies". He declared that some union leaders seemed to be unaware that the petroleum industry belonged to the nation. "This lack of comprehension", he said, "has produced serious difficulties, petitions without limit and a constant increase in expenditures and unproductive charges which weigh down the industry."

Not to make the picture too disheartening the President encouraged the union representatives by promising that appropriations would be made to cover the cost of additional drilling, the extension of pipe lines and the improvement of refineries. He predicted a big increase in exports, which have fallen off sharply since the European war suspended shipments to Germany, said that this would restore depleted revenues and that the workers would receive the first benefits to accrue from improved conditions.

At the same time he warned that a period of retrenchment and rigid economy was necessary before these advantages could be realized. The pay of high salaried officials must be cut and the number of employees reduced by laying off temporary workers taken on since expropriation. The President stated further that certain allowances received by workers must be suspended and overtime must be avoided wherever possible. He assured the workers that in future promotions would be made solely on the basis of merit and appealed to their patriotism to make sacrifices in order that the government's program might be carried through to success.

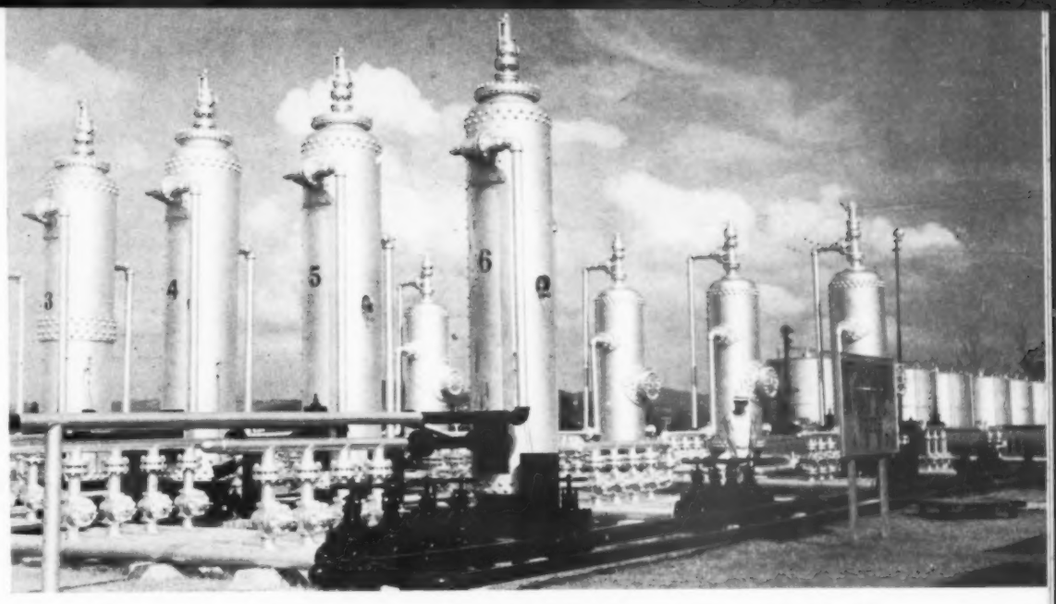
While the President's appeal, with its accompaniment of liberal promises for the future, was intended to have a mollifying effect upon disgruntled workers, Mexican news reports have since stated that a reply drawn up by a committee representing the oil workers vigorously protests his proposals, objecting particularly to the discharge of employees taken on since expropriation, the cutting off of payments in lieu of house rent, overtime and other special allowances.

This action of the unions may not affect the President's course but it vocalizes the discontent over failure to receive the financial and social benefits promised at the time when the oil properties were seized, a feeling that appears to have grown with the passage of time. It accentuates the difficulties of the government which apparently sees no way to fulfil the workers' expectations or even to sustain the present cost of operation except by finding new and larger export markets.

The outlook in this direction does not appear particularly bright. While there seem to be possibilities of expanding business with Japan the insistence of the Japanese upon having control of production and transportation is looked upon apprehensively. Still the general situation is becoming so acute that great concessions undoubtedly would be made in order to turn more of Mexico's oil into cash or some reasonable equivalent.

If the chief claim to success under government control has consisted in keeping the industry going despite the loss of the foreign executives and engineers who were driven out when the oil company properties were seized the outstanding failure has been on the financial side. At the start the government's representatives appeared to have everything in their favor for they took over a huge and well-organized business as a going concern. There was no necessity for earning a return on the capital investment because nothing was paid for the wells, pipelines, refineries, terminals and other facilities built up over a long period of years. Likewise there was no need to make provision for interest charges, depreciation or depletion. Payment of royalties, ordinarily one of the heavy costs of oilfield operation, was suspended.

The only financial problem before the government petroleum organization was to produce enough revenue to pay its operating



Batteries of high pressure separators on left, low pressure separators in center and gauge tanks in background at right in the Poza Rica field just before expropriation.

expenses, its taxes and necessary repairs and replacements. Its inability to meet even these requirements undoubtedly explains the report of Ing. Cortes Herrera and the plain speaking of President Cardenas in addressing the union representatives.

TABLE II

MEXICAN OIL EXPORTS BY COUNTRIES

(In thousands of bbl.)

	1937	1938	1939
Germany	2,521	5,408	6,343
United States*	6,856	2,683	5,456
Italy	186	350	4,750
Great Britain	5,411	1,857	19
Other Europe	1,118	1,416	437
Latin America	1,318	415	460
Neth. W. Indies	4,299	1,097	...
Japan	.....	233	189
Other Countries	1,355	426	431
	23,064	13,885	18,085
Bunkers	1,514	480	960
	24,578	14,365	19,045

*During 1939 Eastern States Petroleum Co. imported 3,687,000 bbl. in bond for reexport, mainly to continental countries of Europe.

Of total exports 72 percent in 1937 was in the form of manufactured products. In 1939 this percentage had fallen to 36, nearly two-thirds of exports being in the form of crude.

The President's report to Congress at the beginning of the year contained certain information relating to oil operations. He stated that proceeds from domestic sales during the year had been 172,000,000 pesos and that export sales had amounted to 75,000,000 pesos of which 40,000,000 had been paid in cash and 35,000,000 in various products under barter arrangements. This footed up to a total revenue of 247,000,000 pesos or 212,000,000,000 eliminating barter supplies which naturally were not directly available for paying expenses.

On the other side of the account the President reported that operating expenses were 130,000,000 pesos and taxes 70,000,000 pesos. Specific items mentioned were 56,000,000 pesos for equipment, plants and materials; 14,000,000 pesos for workers' benefits, including house rentals and savings funds, and 71,000,000 pesos for salaries. To what extent the three last-named items duplicate the first one does not appear clearly from this report.

Published statements from Mexican news sources have placed the losses of the petroleum organization at figures ranging from 22,000,000 to 80,000,000 pesos. This would be equivalent to $6,100,000 to $22,000,000 at 3.60 basis or $4,700,000 to $13,500,000 at current exchange. Whatever the amount, the fact that the industry is operating at a loss presents a serious problem in the present financial state of the Mexican government and is sufficient to explain the President's demand for economy and the strenuous efforts being made to find markets for more export oil.

MEXICAN LAW
Violated By Oil Property Confiscations

The following commentary prepared for WORLD PETROLEUM by a competent legal authority, is based on a careful study of the decision of the Mexican Supreme Court in the case involving the expropriation of oil company properties. By a comparison with legal precedents, constitutional provisions and international agreements repeatedly confirmed by the Mexican Government the author reaches the conclusion that the decision was in violation of all these, particularly in relation to sub-soil rights.

WHEN the Supreme Court of Mexico in December last refused to grant the appeal of the American and other foreign oil companies against the Presidential decree of March, 1938, which resulted in effective confiscation of their properties in color of expropriation, it appears that the tribunal affirmatively and actually did this, among other things: It distorted the law, instead of enforcing it. It distorted the law, instead of enforcing it, by not interpreting it according to its plain, uncomplicated phraseology and its manifest intent and meaning.

In distorting the meaning and application of the law the court, in the judgment of competent Mexican legal authorities, established a case of denial of justice. This is clear to them. What constitutes a denial of justice? That also is clear, and simple. About the most comprehensive and fitting definition that one may search out to fit the circumstances may be extracted from a note sent in March, 1918, going on nearly a quarter of a century ago, by Secretary of State Lansing to the Mexican Minister of Foreign Relations:

> " . . . The seizure or spoliation of property at the mere will of the sovereign and without due legal process, fairly and equitably administered, has always been regarded as a denial of justice and as affording a basis, internationally, of interposition."

There should be no confusion as to the merits and illegality of the petroleum confiscations, nor upon the existence of the foundation which was laid by the confiscatory acts for the later refusal of the highest tribunal in Mexico to follow the constitution and declare that what President Cardenas did was unconstitutional. The fact-seeker has at his disposition, and plainly and irrefutably in evidence, certain clarifying and affirmative factual fundamentals, emanating from Mexican administrative and judicial action.

In considering, evaluating and coordinating these factual fundamentals it is useful as an initiatory step to familiarize one's self with the constitutional provision relating to expropriation of private property which, by their ratification of the petroleum seizures, the magistrates of the Supreme Court distorted instead of enforced. It follows, of course, that unless the organic expropriation law of 1936 adhered to constitutional precept, the statute, and proceedings under it must lack constitutional authority.

Article 27 of the Mexican constitution lays down two prime essentials as being obligatory when any private property is taken over, in expropriation proceedings. The first essential: There must be reason of public utility legally to warrant and justify a property expropriation. The second essential: Full payment for expropriated property must be made when the property is expropriated. These essentials, of course, follow rule and practice in connection with private property expropriations which for centuries have prevailed in all countries wherein organized legal systems have existed. So on this point, at least, no quarrel with the constitution itself may be had. The constitution is all right. There would be no trouble if the constitution itself were enforced. The trouble is with the manner in which Mexico's Supreme Court has distorted, instead of enforcing it; and by this distortion has denied legal relief to aggrieved interests who pleaded and sought for recognition of their rights to protection under constitutional mandate. Included in and supplementing these rights were also the rights guaranteed them by international law, by Mexican jurisprudence, by Mexican Congressional action and by solemn agreements made by the government of Mexico with the government of the United States.

When in December last the Supreme Court clothed with pseudo-legality the confiscations of the oil properties, besides barring recourse in the Mexican courts to the appealing owners, it did this: It was able to manage its calculated and elaborate law-distortion only by directly and completely reversing itself in every decision involving kindred issues taken by it in the past twenty years.

In these cases it had consistently held that the constitution must be followed, insofar that: First, a real reason or cause of public utility must exist in fact and must be proved in any condemnation or expropriation proceedings. Second, payment for property must be made by means of (mediante) indemnification, and this indemnification must be paid with the taking of the property, or, in the phrase employed in one of his temperate and logical remonstrances to the Cardenas government by Secretary of State Hull, by "adequate, prompt and effective payment" when the owners lose possession and use of their properties. There have been many decisions of the Supreme Court holding that an indefinite promise to pay, or to pay by installments or within a fixed period after the seizures is unconstitutional. No decisions contrary to the latter judgments have been made, except in connection with the petroleum property seizures.

It is difficult to escape the conclusion, on the facts, that the Court spared no effort to establish the apparent legality of the confiscations. It did this regardless of the degree to which it might go against the constitution and every other guide which said that the government could not do what the court decided that the government could do.

That what the court ruled in connection with the petroleum confiscations was planned and deliberate, seems obvious, when numerous significant, correlative and antecedent facts are given due ponderation. The detailed process and sequential progress of events by which the way was paved for approval of the seizures by the court are too notorious and overt to require recapitulation here. It suffices to take up the tale and continue it at, and from, the point where the tribunal began to place and finally did place the cumulative touches upon the confiscations. President Cardenas reduced the tenure of the magistrates from life to six years. Thus the court was rendered subject to political influence, instead of maintaining its independence as a law-interpreting and law-enforcing body.

The subservience of the court to the executive branch of the government was advertised to the nation by the federal Attorney General as early as May 7, 1937. He made a formal call upon the magistrates, and then announced that his reception had been friendly, and that he was confident that as "a helping element" the Court would show the country that under the Cardenas regime there existed a "public administration dedicated only to the service of all social sectors of the nation."

Justice Javier Icaza followed this later,

when the oil confiscations were before the court, with a public declaration which did two things: It confirmed the Attorney General's confidence that in his court President Cardenas would find a "helping element." It also revealed that the real reasons and motives for the confiscations were not economic or social, but political. For Justice Icaza was either ingenuous enough or commensurately indiscreet to proclaim that, in his capacity as a magistrate of the highest court in the nation, he had acted against the oil companies "continuously, firmly and passionately . . . in spite of being a justice of the court because it (the controversy between the companies and their labor) is not a conflict of a legal character, but a serious conflict of a political character . . . "

At a cabinet meeting held March 18, 1938, the day President Cardenas issued his decree of confiscation, the Chief Justice of the Court, Magistrate Daniel Valencia, assured the President (according to EL NACIONAL, the official government newspaper) that he considered himself "authorized to opine that the Judicial Power itself—as the Legislative Power also would certainly do—would join with the Executive Power in the consequences of its patriotic action." After the properties were confiscated the Chief Justice in a public address stated that in ruling against the companies the court had "interpreted our (Mexican) laws with the deep revolutionary spirit that inspired them."

A general view of Poza Rica Camp taken shortly before expropriation. The bulk of Mexico's present production comes from this field, produced by natural flow from very extensive reserves.

Study of the Supreme's Court's decision of December 2, 1939, discloses at least five outstanding conclusions of the magistrates which contradict previous decisions.

First: That despite the constitutional prohibition against expropriation of private property "except for reasons of public utility and by means of compensation" the Mexican nation nevertheless had a right to deprive the owner, lessee or concessionaire of the surface of his right to the tangible or commercial value of the oil in the subsoil, after he had reduced it to possession. And that when the nation did this it was not taking from him any possession of a tangible or commercial value, and hence need pay no compensation for subsoil oil.

It is well understood and established, of course, by all previous Mexican jurisprudence and international agreements, that both of the two classes of oil concessions existing in Mexico—those granted before the promulgation of the Constitution of 1917 and those granted after—carry with them the right to reduce the oil in the subsoil to possession.

Second: That summary administrative seizure of the oil companies' property was valid, regardless that Article 27 of the Constitution and the organic expropriation law provides that expropriation shall be accomplished solely through judicial procedure; and that this procedure requires establishment of the necessity for the expropriation, designation of the special property to be taken, and occupation of the property only after judicial hearing and payment of compensation.

Third: That although according to Article 27 of the Constitution compensation must accompany expropriation, and the court had previously held on numerous occasions that this compensation must be certain and effective, that is, in cash, the court now holds: That Article 20 of the expropriation law is constitutional, despite that it permits payments over a period of ten years, but that the oil confiscations are excepted from the operations of the constitution because the value of the property is beyond Mexico's capacity to pay promptly, and that the decree under which the properties were seized leaves the question of payment uncertain and contingent, inasmuch as payment is to be made from an undetermined percentage of the future production of oil from the confiscated properties.

It may occur to some that in pleading that "the value of the property is beyond Mexico's capacity to pay promptly" the court did this: Advantaged itself of Mexico's notorious state of bankruptcy, so far as concerns her capacity to meet her obligations, to distort the laws, to attempt to adjust the law to this condition, instead of ruling that the law must be enforced, regardless of this condition.

Fourth: That the mere assertion of the President that facts existed to justify expropriation was accepted by the court as true, although the executive's alleged facts were not in evidence and the President's statement that they were facts was unsupported by evidence. Hence, the ostensible reasons had no legal existence or standing, while the real reasons, proclaimed as being penal and so-called social, provided no legal justification for expropriation.

Fifth: That the only compensation to which the companies are entitled is limited to the capital legitimately expended in order to reduce the subsoil oil owned by them to possession, plus the tax value of real estate and the cost of installations. This ruling ignores that heavy investments are made in exploring unproductive territory and that these costs constitute a definite charge on the industry, even though an assumption might be set up that, contrary to facts and the law, investment could be made the measure of value.

According to President Cardenas, and in face of conflicting facts of record set up by his own official acts and the acts of his Supreme Court, even-handed justice has prevailed in dealing with the oil companies and the properties of their shareholders. For in a recent formal statement the President observed:

"The government considers that in the matter in question there has been no denial of justice in any of the aspects of the expropriation of properties of the oil companies, nor has the government refused to make prompt and just compensation. . . ."

This is given as the official and apparently uncompromising, attitude of the President. His utterance invites the observation that it appears to constitute a clear example of bad faith by asserting a readiness to pay for confiscated properties only after first eliminating from consideration the bulk of the value of the properties involved.

The Supreme Court has ruled that the owners of the confiscated properties have no ownership in the oil in the subsoil. Hence it is futile, taking this fact in consideration with others that are germane to the case, to expect Mexico to make even token payments. So the despoiled companies have no recourse other than to insist upon the illegality of the confiscations, made, as they were, in violation of Mexican law, of the Mexican Constitution, of Mexican jurisprudence and of signed, sealed and delivered agreements voluntarily entered into by the government of Mexico with the government of the United States. Consequently the companies have exercised their right of demanding that the properties of their shareholders be restored to the management of the representatives of the shareholders.

POLISH OIL INDUSTRY

Under German Control Concentrates on Military Supplies

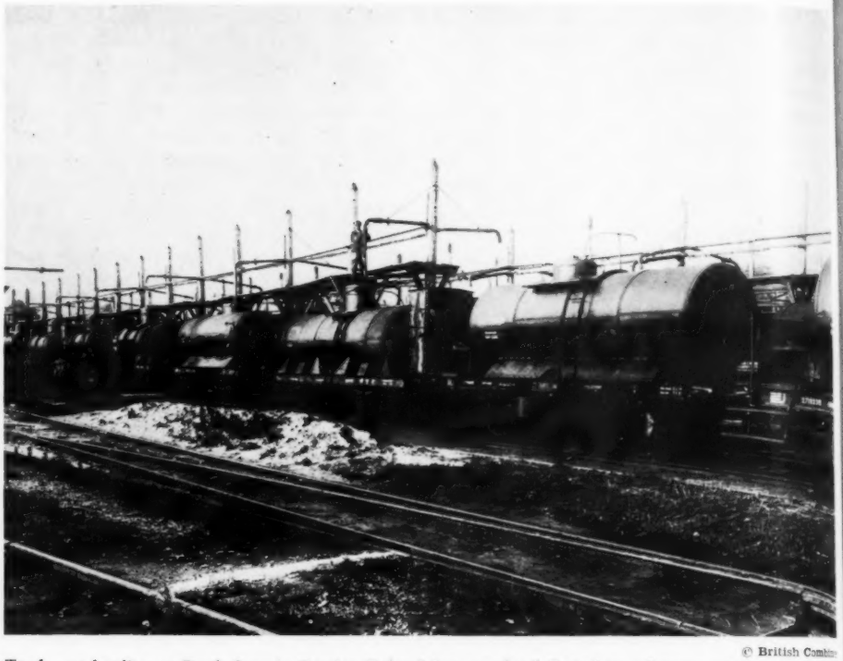
SINCE the collapse of Poland, in September last, there has been much speculation as to the part that might be played by the Polish oil industry in supplying petroleum products to meet Germany's urgent war demands. Poland is one of the minor oil producing countries with an annual output that in recent years has averaged around 3,800,000 bbl. or about two-tenths of one percent of the world's total. Nevertheless any addition to Germany's available supply of natural oil would be of importance under present conditions. So far as the former Polish territory can contribute to Germany's petroleum needs it will be made to do so as long as the war continues.

In the division of Poland between Nazi Germany and the Soviet Union the former received about one-third of the production and the latter two-thirds. This is based on past output and does not represent necessarily a similar division of reserves. Russia obtained control of the Boryslaw field which is the largest and best known in former Poland as well as the less productive fields, Rypne, Bitkow, Schodnica and Uryce. The combined output of this entire group has been about 2,200,000 bbl. annually. Russian Poland also contains 23 refineries but these are for the most part the older and smaller establishments and only one of them includes a cracking plant.

According to official statements from Berlin the area taken over by Germany is placed under two separate classifications. The territory which belonged to Germany before the first world war has been definitely annexed. Another portion in the central part of the country is to be formed into an administrative district with the ultimate purpose apparently of becoming a sort of protectorate with a status similar to that of Bohemia—Moravia. For the time being, however, all this part of the country may be regarded for practical purposes as forming part of the German Empire.

German Poland comprises roughly 60 percent of the former Polish area with about 63 percent of the population. It includes practically the entire industrial region and all the important cities except Lwow. It takes in the oilfields west of the San River extending to Gorlice. In this area are nearly 1700 wells or 400 more than in eastern Poland but the annual production is only slightly over 1,000,000 bbl. yearly.

The industrially developed portion of Poland, the part taken over by Germany, heretofore has accounted for roundly 80 percent of the total consumption of petroleum products or upward of 2,600,000 bbl. Since its own production has been only about 1,000,000 bbl. it would be under the necessity normally of importing 1,600,000 bbl. On the other hand Soviet Poland, which now is designated as Western Ukraine, has a surplus above its own requirements of approximately an equal amount.



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Tank cars loading at Drohobyez in Russian Poland just north of Boryslaw: whatever oil can be spared from domestic needs in this part of Poland is shipped to Germany, although transportation presents a major difficulty.

At the time of partitioning it was reported that an arrangement had been made between the conquering nations by which Germany was to receive the surplus oil from the eastern area and possibly would undertake to work the fields in the hope of increasing their output. This is not supported by more recent publications in Soviet journals, but in view of the difficulty of transporting oil from the newly occupied territory to points in the Soviet Union where it could be used it seems probable that this oil will go to Germany, at least for the duration of the war.

Up to a few years ago Poland was exporting 200,000 tons or more of petroleum products. The rise in domestic demand, however, had reduced these exports to merely nominal dimensions by 1939. Under wartime regulation, with commercial use reduced to an absolute minimum, most of Poland's oil will go to strengthen Germany's military effort.

So far as can be learned neither the oilfields nor the refineries of Poland suffered serious damage during the September invasion. German airplanes apparently were careful not to bomb industrial plants. The largest refinery in the country worked uninterruptedly during the military campaign. This and other refineries have continued in operation since, retaining in most cases their Polish operatives but with Germans in charge in each instance. Thus the petroleum plant of the country, such as it is, remains in as good condition as before the war.

At the present time three commissions, covering the three districts into which the country is divided, exercise complete authority over all operations of the former Polish oil industry, including production, refining and distribution. Refiners must turn out products in such proportions as directed. Nobody can either buy or sell without a permit and, except for government officials and essential industries, practically no permits are issued. Those in charge of manufacturing plants are responsible with their property and their lives for infractions of regulations. With the knowledge that penalties will be rigidly enforced no violations of the rules occur.

While German authorities have taken over control of oilfields and refineries there has been no move toward confiscation of the properties. Business forms are observed and records are kept in the customary manner. The chief difference from pre-war operations is that attention is concentrated on products chiefly needed by the military machine whether or not these are economically the most profitable. Since, however, the government and its agencies are the chief customers, operators would have no choice in any event. In the case of companies under foreign ownership certain reports are permitted to go to the owners but these reveal no details of output or operations.

Very different is the picture across the

border in Russian Poland. Here the new masters, in true Soviet fashion have seized the properties, expelled the owners, removed all stocks in storage and have organized the industry into a government monopoly under the name of the Ukrneft. Likewise according to usual practice an elaborate plan of expansion has been drawn up. According to this plan, as set forth in the Soviet press, Ukrneft will drill during 1940 a minimum of 200,000 metres of producing wells besides a large amount of exploratory drilling. If this program is carried through footage drilled will be considerably more than double the average for the past ten years for all Poland under private operation. Furthermore it is stated that in addition to drilling 300 new wells in the eastern fields, refineries are to be newly equipped and improved transport facilities provided. The last mentioned step is necessary if oil from the new province of western Ukraine is to be moved to industrial centres. How much of this program will be carried out within the time specified remains to be determined. One thing appears certain however. That is that the oil properties in this area are lost to their rightful owners so long as Soviet domination continues and that claims for compensation will be ignored.

While the tendency of the Soviet is to lay down ambitious expansion plans, carrying them to successful conclusion is another matter, and the example of the Russian oilfields makes it most unlikely that production will actually be increased, especially as close cooperation from Polish oilfield workers is an element of doubt. In the Russian section deep wells are on electric or steam swabbing machines and the wear and tear of equipment is very heavy. When a line breaks several days are nearly always required for fishing for the swab. Production lost during this period is never regained, as the oil seems to seep back through the fissues and cracks in the strata.

Three possible means of increasing production in former Poland exist. All of these are likely to be employed, particularly in the territory acquired by Germany. One is by intensifying pumping operations. It is understood that this already is being done, not only in Poland but in the Austrian and Czechoslavakian fields that have come under German control, and that all these wells are being pumped hard at the present time.

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Boryslaw oilfield in Russian Poland lies on a great plain close to the Carpathians and produced 70 per cent of Poland's crude from discovery in 1855 to the partition of Poland in 1939.

A second means of increasing output is by the introduction of air lift, water flooding or other means of increasing pressures. Repressuring has been practically unknown in Poland heretofore and while some wells are of a type where such methods of increasing recovery are not feasible there are other areas where they can be applied.

The third possible means of enlarging production would be by new drilling. While some of the Polish fields have been worked for from 50 to 70 years most of the wells are shallow, ranging from a few hundred to 3—4,000 ft. Few wells exceed 5,000 feet in depth. Modern methods of survey and exploration have been used very little.

In the territory occupied by the Nazis most of the production comes from privately-owned lands consisting of small parcels, and between the producing fields are many sectors of state-owned land which remains largely undrilled. A considerable part of such land is wooded, and presumably preserved for timber. Should these state-owned lands now be drilled expertly under one direction or management the possibilities for increased production are very favorable.

Expert opinion leans to the view that while some expansion in the oil output of former Poland is possible, no great increase in production is likely. As stated above, however, any addition to Germany's very limited well production, no matter how small, would assume importance in view of the shutting off of overseas shipments. Undoubtedly, therefore, the resources of the Polish fields will be exploited to the fullest possible extent and this may add 2,000,000 bbl. more or less to Germany's annual supplies.

At the same time it must not be forgotten that Germany is forced to maintain a sizable armed force in her Polish territory, and the petroleum requirements of their army and air force must be substantial and will to an extent eat into the country's production. Also, it may be presumed that the Nazis are demanding a steady stream of munition, industrial and agricultural supplies from Poland and importing the same into Germany. Gasoline and lube oil will be needed for movements of the raw and finished products, further depleting petroleum shipments into Germany.

Refinery at Drohobyez in Russian Poland owned and operated by the state before the Soviets took over. Drohobyez was an important refining center which is now controlled by Russia—but much of the equipment is very antiquated.

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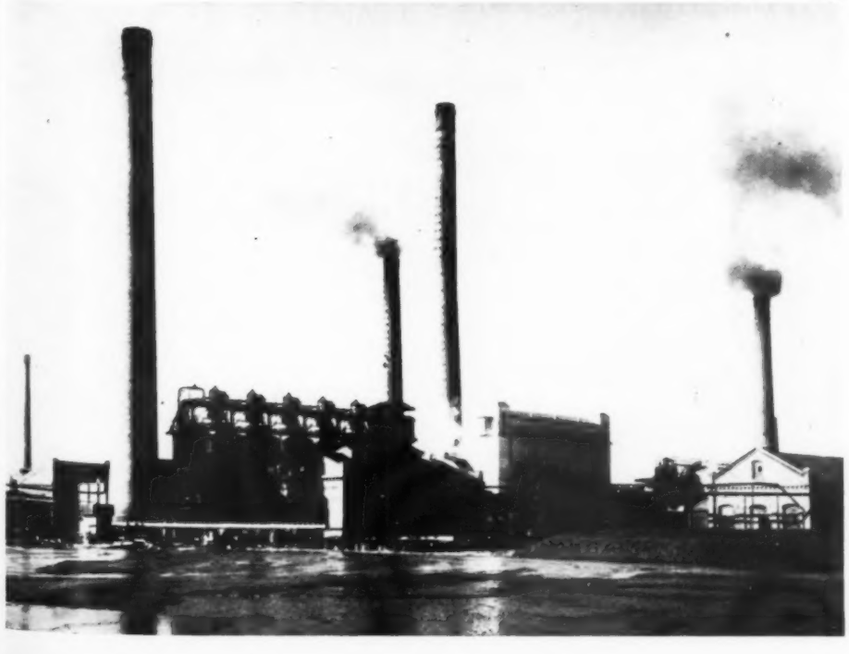


REFINERY ADJUSTMENT

May Correct Unbalanced Supply of Light Products

In March World Petroleum Published an Analysis of the Unbalanced Position in Demand for Motor Fuel and Distillate Fuel Oil by an Executive of a Large Petroleum Organization, Who Concluded His Review With Some Practical Suggestions. There is Published Herewith an Investigation of the Technical Limits to Which Adjustments in Supply Can be Made in the Refinery, Prepared by an Expert, Thoroughly Familiar With the Problems Involved.

THE abnormal and protracted cold weather along the Atlantic Seaboard this past winter, which extended to the Gulf States for a period, superimposed on the sharp upward trend of distillate fuel demand during the past five years, resulted in a demand that refiners were able to meet only with considerable difficulty. Although, through heroic efforts, a serious shortage of supplies was averted, the meeting of this demand did result in the concurrent production of more gasoline than was desirable, which, with gasoline stocks already high, brought them to a level sufficient to depress prices and threaten to unbalance operations over the coming year.

The trend of increasing gas oil and distillate fuel demand in the U. S., referred to above, in comparison with that for motor fuel, is shown in Table 1. The tendency of motor fuel production to exceed demand having already become embarrassing in seasons when abnormal weather has increased the demand for distillate fuels, it is clear that, if the trend shown continues, this over-production of gasoline will become a normal, rather than an unusual occurrence. Since the continued production of motor fuel in quantities greater than demand could not be maintained indefinitely, will this situation correct itself, and what possibilities of correction exist?

There seems to be no possible means of adjustment other than for a change of prices to result in a change of demand, or for physical changes in the source or method of producing supplies to allow a change to be effected in the ratio of production of gasoline to gas oil and distillate fuel, or some combination of these two changes. Since demand, particularly for gasoline, is relatively inflexible to price, and since a change in crude supplies would be slow to realize, and would not greatly affect possible relative yields of products, it would seem that the industry must rely principally on technical changes in processing to make the necessary adjustment of yields. As will be pointed out below, there is reason to believe that such changes can make possible adjustments considerably beyond the needs of the present, and provide leeway to care for the trend for considerable time into the future. Since the necessary technical changes would not require inordinate investments, and would occasion little or no increase in net operating costs, it is felt that the industry will be occasioned but little difficulty in effecting the necessary adjustments in yields, and keeping the situation under control during the next few years.

In support of the point that a considerable increase in the yield of distillate fuel at the expense of motor fuel can be effected, one example of what has already been accomplished can be cited. One refiner, with an average crude supply comparable with that of the industry in the regions tributary to the East Coast*, had average yields, compared with those of industry in this region, during 1939, as follows:

	Average Crude °API	Percent on Crude: Gasoline	Kerosene	Gas Oil and Dist. Fuel	Ratio Gasoline to Gas Oil and Dist. Fuel
One Refiner	34.8	36.5	8.6	17.1	2.14
Industry tributary to East Coast,*	35.1	43.5	6.7	14.6	2.98

*For purposes of this comparison, areas tributary to the East Coast (which are the ones where this problem has become critical) have been taken as the areas covered by the Bureau of Mines reports for the "East Coast", "Texas" and "Louisiana and Arkansas" areas. It is appreciated that a portion of the refined products from these areas (particularly from Arkansas, inland Texas and northern Louisiana) does not reach seaboard, but it is felt that this is very small, and that their inclusion does not materially affect the above comparison.

It will be seen that this one refiner has taken 2.5 percent on crude more gas oil and distillate fuel than the industry at large, and that this was after also taking a larger yield of kerosene. Since kerosene can be blended into some of the lighter distillate fuels, it may be said that, had this refiner taken only the same kerosene yield as industry, it could have taken a yield of at least 19.0 percent gas oil and distillate fuel, or 4.4 percent more on crude than industry. Had industry taken this same yield, supplies would have been increased 30 percent or to 127,000,000 bbl. in comparison with a demand of 100,000,000 bbl. The possibility of adjusting yields is further demonstrated by the fact that this refiner produced in February, 1939, a peak yield of 21.1 percent of gas oil and distillate fuel, against a peak by the industry in these regions of 16.6 percent, also in February. Thus further increases in supplies are possible by running, if necessary, to peak yields possible on a year-round basis, storing production in the summer in anticipation of winter requirements.

Table 1

Comparison U. S. Motor Fuel vs. Gas Oil and Distillate Fuel Demand, 1935-1939—Barrels, 42's Areas Tributary to East Coast

	Motor Fuel Demand	Gas Oil and Distillate Fuel Demand	Ratio
1935	227,000,000	56,000,000	4.05
1936	249,000,000	70,000,000	3.56
1937	278,000,000	84,000,000	3.31
1938	290,000,000	89,000,000	3.26
1939	302,000,000	100,000,000	3.02

It would seem that if industry would make itself sufficiently flexible to reduce its ratio of gasoline production to gas oil and distillate fuel production to near 2, as the refiner above was shown to have done in 1939, this should take care of the decreasing trend in this ratio for a good many years. In an attempt to look still further ahead, and to demonstrate further the possibilities of varying yields at will, approximate estimates have been prepared of the maximum yields of gas oil and distillate fuels that could be produced from the average crude refined in the area tributary to the East Coast, maintaining production of gasoline, kerosene, and lubes and miscellaneous products in the same ratio to each other as is their current demand in this area. Assuming only conventional distillation and thermal cracking equipment to be employed, these calculations show that gas oil and distillate fuel yields could be increased to 32.6 percent on crude, and the ratio of gasoline to gas oil plus distillate fuel production reduced to 1.06. A refinery flow plan, indicating how this might be accomplished, is shown in Figure I.

The question immediately arises as to the expense necessary to provide the necessary

greater flexibility in industry's equipment. The extent and nature of the changes would, of course, be different with each specific installation, but, in general, it is felt that the expense would be relatively small, particularly when viewed with reference to the advantages so effected. Considering the general nature of changes required to maximize distillate fuel yields, it will be appreciated that since, when a stock of a given boiling range is put through a cracking zone, some fractions are lost from this boiling range, being converted to both lighter and heavier material, and therefore yields of material boiling in the distillate fuel range will be increased as care is exercised to minimize the cracking of such fractions. In practice, this means that, when not prevented by high cold test, all virgin stocks of suitable boiling range, in order to maximize distillate fuel yields, should be cut directly into distillate fuel without cracking, and likewise that the recycling of such stocks produced in cracking operations on heavier gas oils or residuals should be minimized. This latter variation in operations might require, in some plants, revision of, or addition to the fractionating equipment on cracking units.

In general, industry is already using a relatively large portion of available virgin stocks in distillate fuels, and a large increase in yields would be accomplished, principally, by using increased quantities of cracked stocks (which at present are not included at all by some refiners) in distillate fuels. Since cracked fractions are more unstable as regards color, odor, sediment, acidity, etc., this change would require more extensive use of treating and rerunning than at present, particularly for making the premium grades of distillate fuels, so the installation of such facilities would be the second item of expense necessary if the industry is to reach the desired flexibility.

As a credit against the cost incurred from these additional operations, the amount of cracking per barrel of total gasoline production is decreased as more straight run gasoline from added crude run is substituted for the cracked gasoline previously produced from cracking the heating oil fractions now to be withdrawn from cracking operations. While additional reforming of straight run naphtha is required to balance octane quality requirements, the net reduction in cracking costs (both operating and investment) is adequate to offset the added cost of finishing the additionally produced cracked heating oil supplies.

To an extent, the changes necessary to increase yields of distillate fuels can be reduced by alternative expenditures for tankage which will allow refiners to take yields throughout the year more nearly corresponding to average requirements, accumulating surpluses against seasonal demands, and avoid the necessity of facilities for producing extremely high seasonal yields.

It will be appreciated that, as distillate fuel yields are increased, the ratio of production of residual fuels to gasoline will tend to decrease, and hence residual fuel production, in relation to gasoline production, will tend to decrease. It is not felt that it will be advantageous to refiners to maintain this production ratio. Aside from running crudes of heavier gravity, there are only two ways in which industry can do this, and both would seem undesirable. If more crude is run in the most economical manner (i.e., for minimum residual fuel production) this would obviously result in over supply of other products when supplying residual fuel requirements, which is the difficulty for which a way is being sought to avoid. The only alternative is to run additional amounts of crude without increasing the production of products other than residual fuel, which is obviously equivalent to throwing additional quantities of crude directly into residual fuel. This is both uneconomical for a refiner and a waste of the country's high gravity crudes.

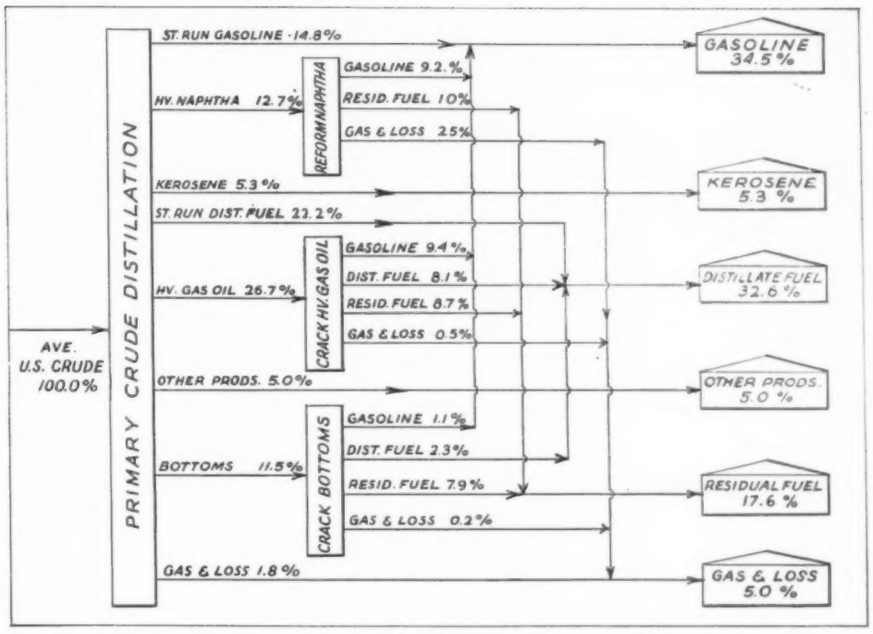


FIGURE 1 — Processing 34.4 deg. A.P.I. U.S. crude for maximum ratio of distillate fuel oil to gasoline by conventional distillation and thermal cracking methods with yields of gasoline, kerosene and other products in same ratio to each other as ratios of 1939 demand. Yields shown include finishing and treating losses.

In summary, it is concluded that, as the rate of increase in heating oil demand continues to exceed the rate of increase in gasoline demand, serious oversupply of gasoline will result unless the ratio of heating oil to gasoline yields on crude can be substantially increased. That this can be done has been demonstrated by at least one refiner's experience, and a consideration of the possibilities inherent in the maximum utilization of existing refinery techniques on available crude supplies indicates further potential improvement in this ratio.

PRESIDENT PROPOSES MODIFIED FEDERAL CONTROL

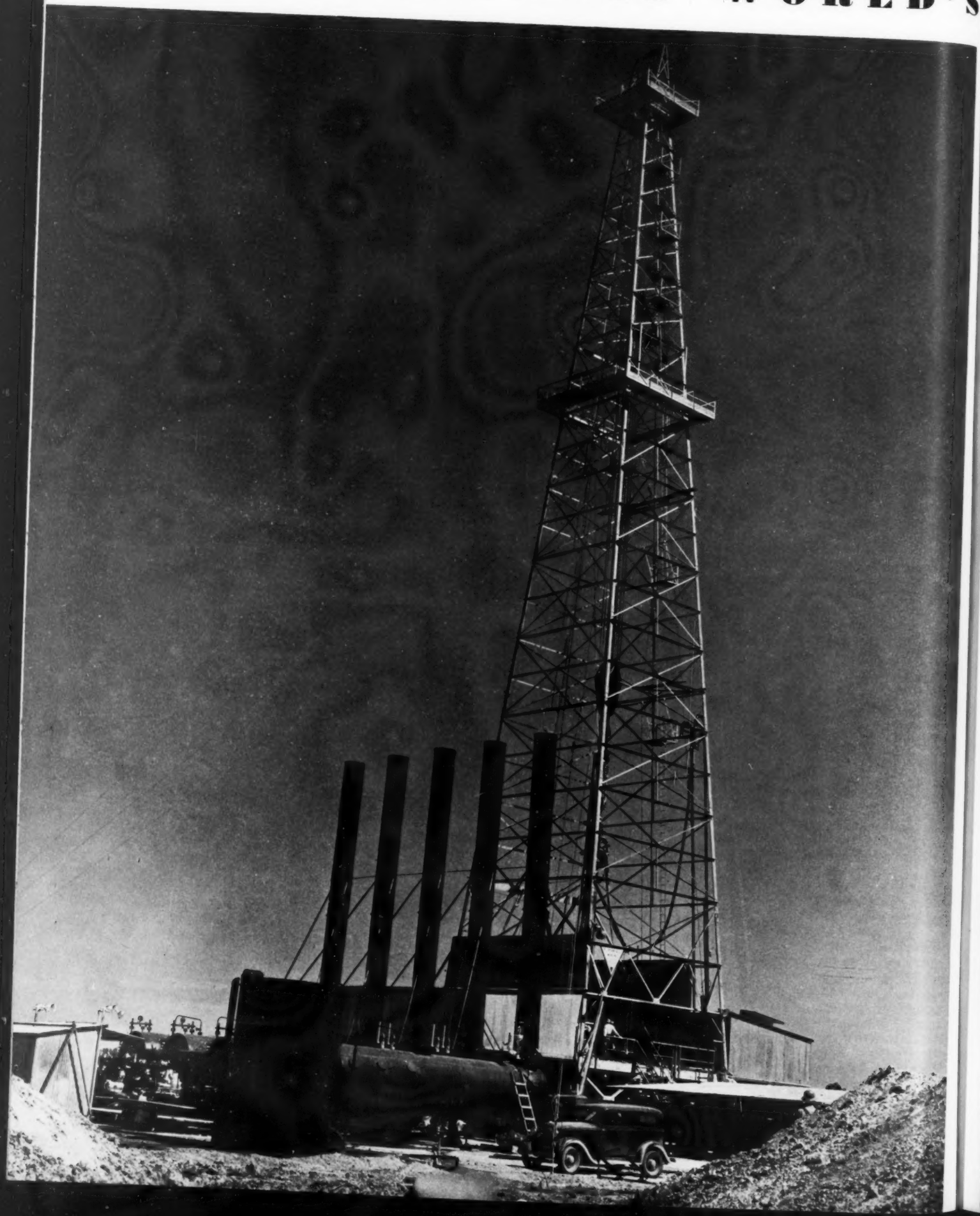
BOWING to the weight of the opposition offered to the Cole subcommittee of the House Interstate Commerce Committee to the Administration's bill to extend federal authority over the petroleum industry President Roosevelt has suggested a "new approach" to the problem as a compromise for the measure sent to Congress last July.

Briefly the legislation now proposed would authorize the federal government to prescribe standards of production to which oil producers would conform as condition to shipment in interstate commerce. In turn federal enforcement would be limited to states failing to enact laws in compliance with the standards. In so far as the states fail to enact or enforce oil conservation laws in conformity with federal standards oil producers would be given the right to qualify their shipments by entering prescribed voluntary agreements.

In a word the bill which the Department of Interior is now expected to draft for submission to the Cole committee envisions an extension of the principles of the Connally hot oil act and a broadening of the oil state compact. Viewed in the light of the testimony presented to the Cole committee by representatives of the oil-producing states the industry and its trade associations the program appears aimed in some measure at least at states not party to the compact notably California and Illinois.

The compromise for the original Cole bill was advanced in an exchange of correspondence between Representative Cole of Maryland, chairman of the subcommittee and the President. Its passage in the present session of Congress appears doubtful.

SUPERIOR SETS WORLD'S

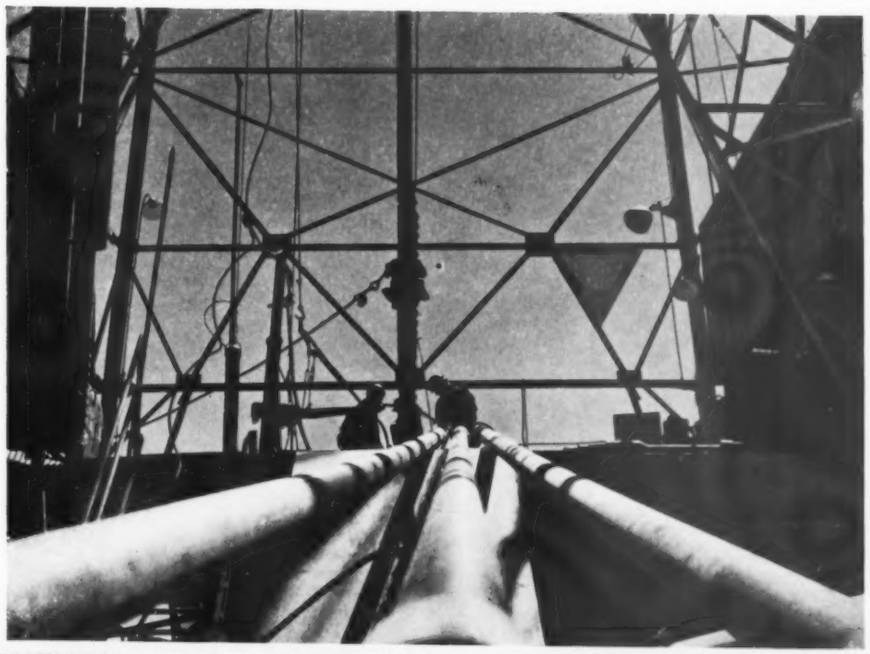


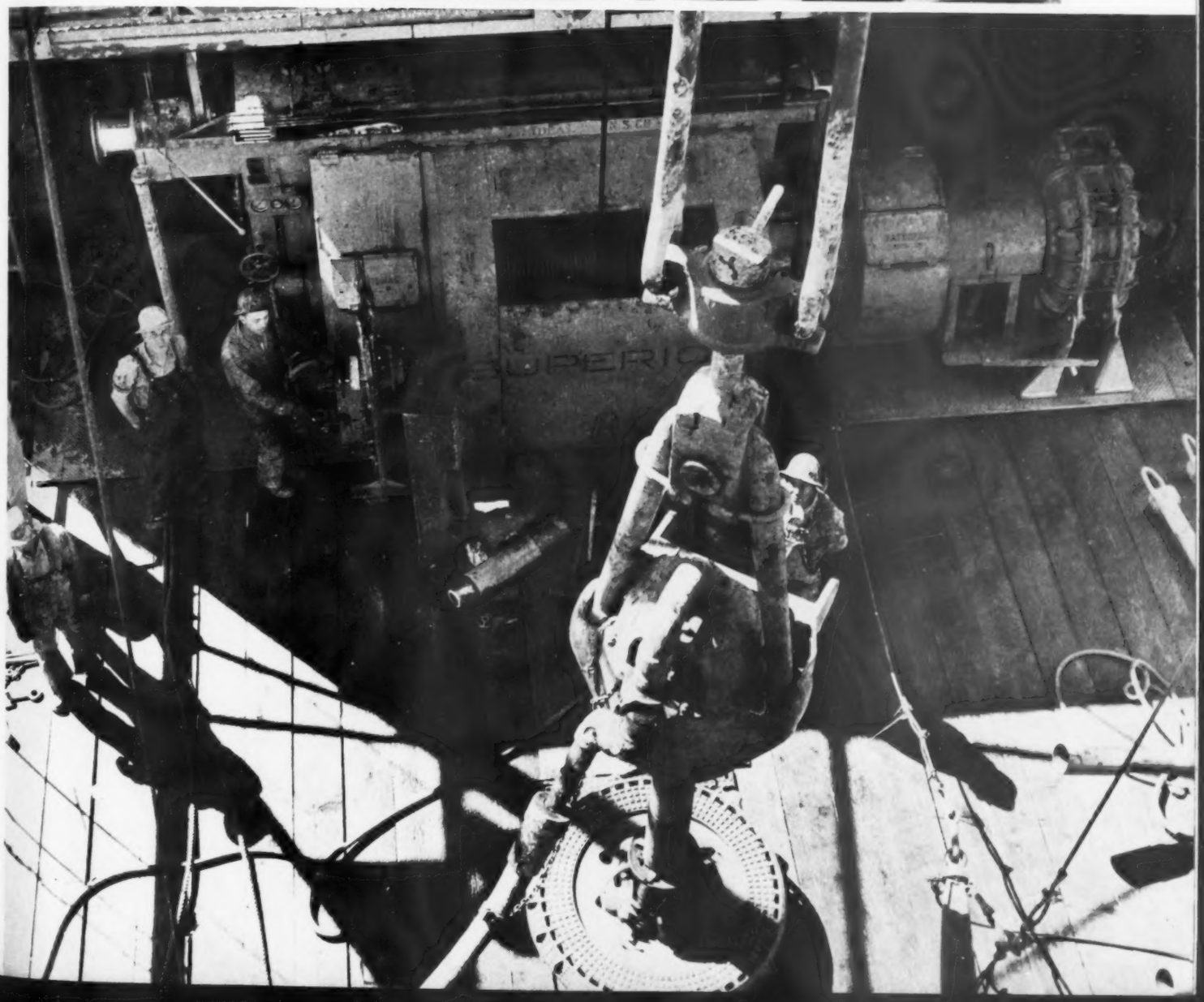
RECORD FOR DRILLING SPEED

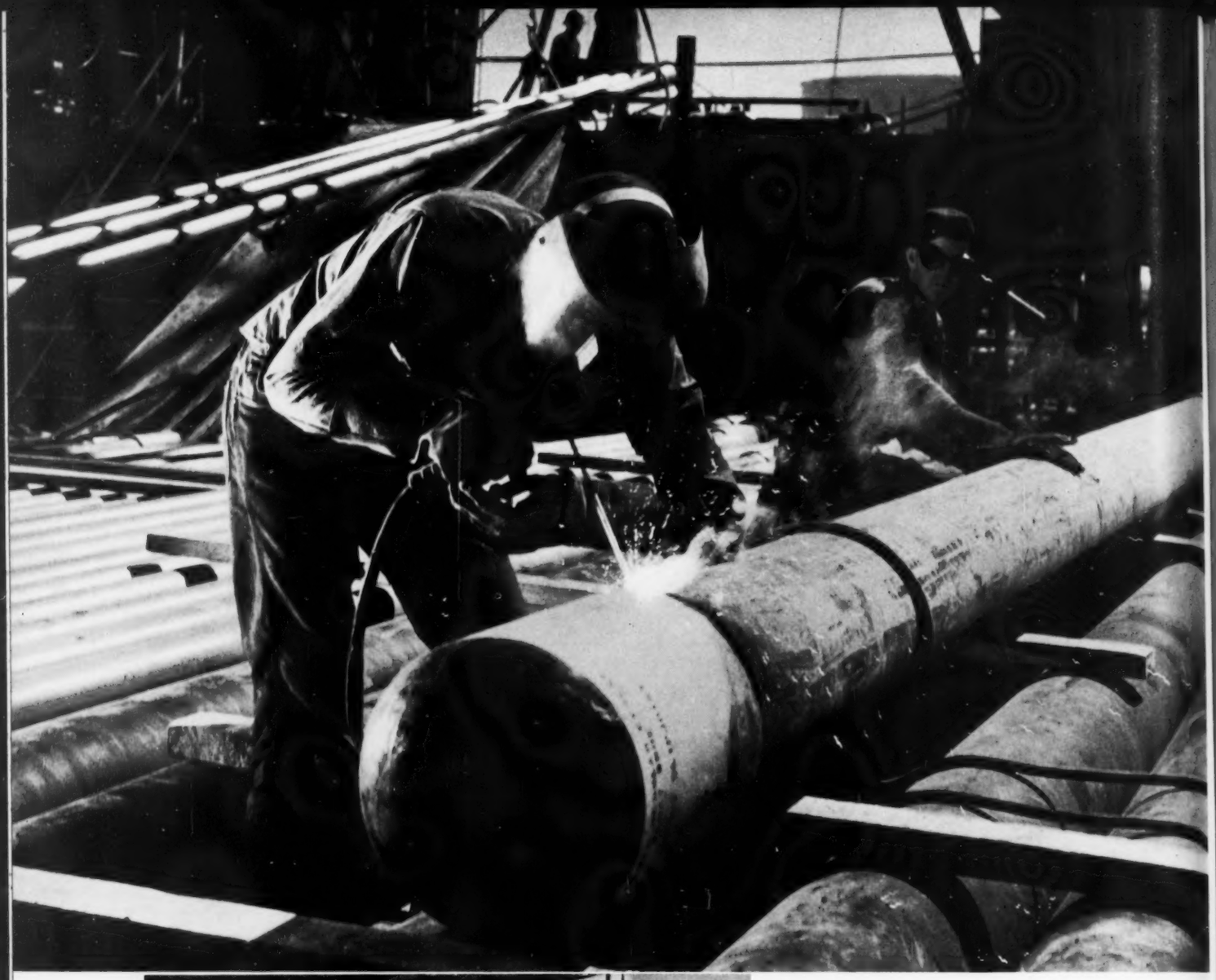
CALIFORNIA, land of records, to whose oilfields come petroleum engineers from all quarters of the globe to study methods and practice. Here the world's deepest wells are drilled, here in warm sunshine derricks sprout to 190 feet. Rig boilers operate under tremendous pressures, bits whirl downward at incredible speeds. On these and the following two pages the latest (at time of going to press) record is illustrated in pictures taken by Cy La Tour & Son expressly for WORLD PETROLEUM.

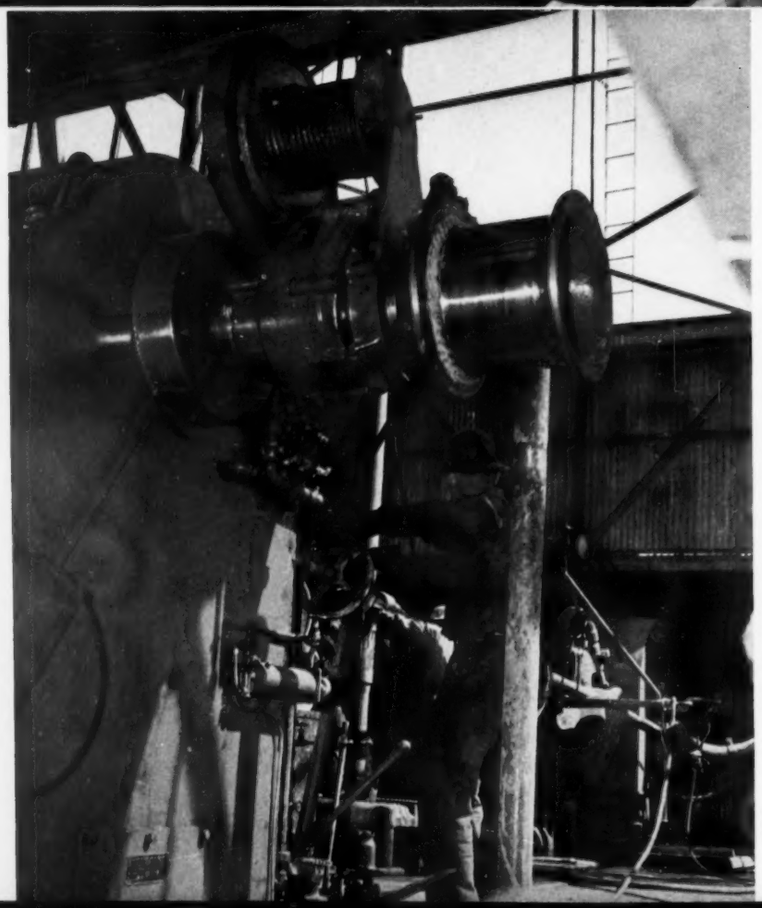
At 7:10 a.m. on the 22nd of March Superior Oil Company spudded Weber No. 2 in the Rio Bravo field. Seven hours later the bit was biting into rock at 1,383 ft. below the surface—a world's record for drilling speed.

On the left may be seen the derrick towering 187 ft. above the ground and the battery of five 125 h.p. 500 lb. working pressure superheated boilers, the two 10 kw. generators, and the 15½ in. by 9¼ in. by 22 in. mud pumps. At right drill rod in place ready to take off on its record run. Below, looking down on the derrick floor.



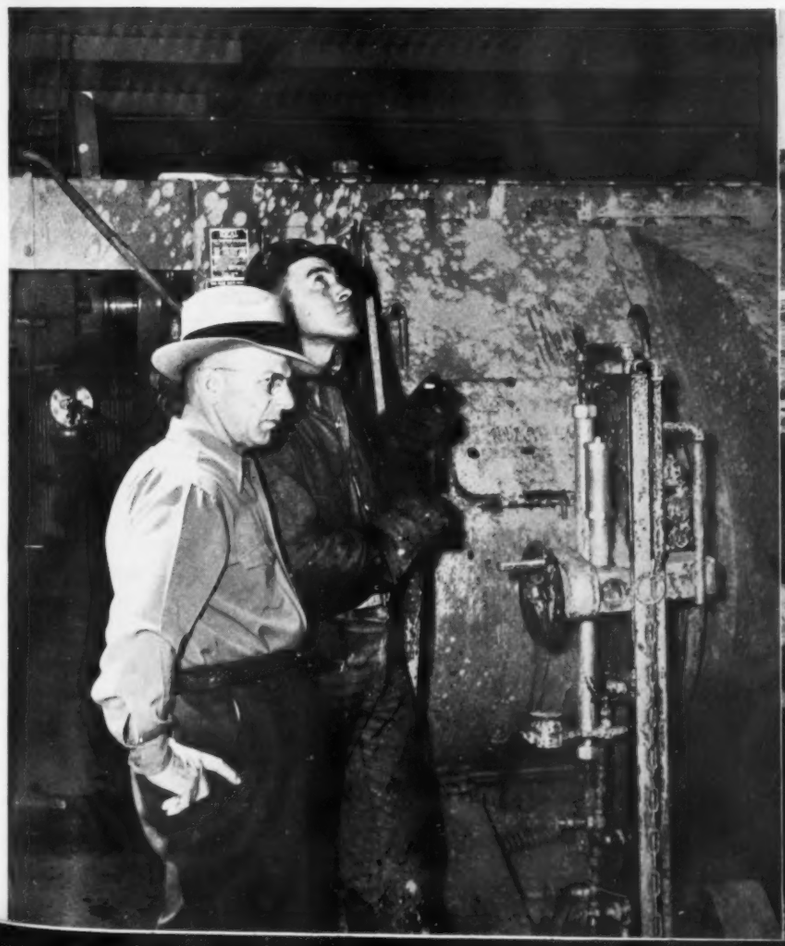






WORK proceeds on Superior Oil Company's Weber No. 2 in the Rio Bravo field in California where a highly efficient drilling crew supplied with the heaviest and most up-to-date equipment available is engaged in setting a world's record for drilling speed. Further photographs made expressly for WORLD PETROLEUM by Cy La Tour & Son continue the story of Weber No. 2's speed record. Above, casing being welded preparatory to being run into the 12¼ in. hole that was carried to the 1,383 ft. level. The draw works used, illustrated on this and the preceding page, is the largest in the world and was built at Torrance, California, especially for Superior Oil Company. In the oilfields on the Pacific Coast, Superior has acquired a reputation by calling for ever bigger and heavier drilling equipment, then handling it in the manner illustrated on these pages and hanging up new records in the land of records. Some idea of the size of the draw works may be gathered from the picture on the left. The take-up winch towers above the driller's head.

On the top of the opposite page may be seen Superior's driller, Kelley Kindall on whose judgment of weight and control the drilling speed record, the very well itself depends. At lower right, Drilling Superintendent, Tommy Vaughn, peers at the instruments while Kindall takes a look aloft where the crown block rests 176 ft. above the derrick floor. At the extreme right, the experienced crew breaks out drill pipe to insert a new stand—without appearance of haste the heavy equipment is swung about with remarkably little effort and without waste motion. Even the Soviet's Stakhanov might learn a few tricks from California's drilling crews. . . . .



INTENSIVE EXPLORATION IN NETHERLAND INDIA

THE disturbed political situation in the Far East which has been developing rapidly in the recent past has served to concentrate unusual attention on the rich oil regions of Netherland India. First production in this area came from Sarawak, where Sarawak Oilfields Ltd. started commercial production in 1910 on a concession obtained from the Rajah, Sir Charles Brooke. Latest figures reveal that the total production for Netherland India including the fields of Sumatra, Borneo, Java and Ceram for the year 1939 amounted to 7,943,000 metric tons. Within the last few years a very active exploration campaign using the most modern equipment has been carried on, adjacent to the older producing fields and also in entirely new areas of this great archipelago.

The companies principally interested in this area will be referred to by their initials for the sake of simplicity. They may be listed as follows:

N. K. P. M.—Nederlandsche Koloniale Petroleum Maatschappij (controlled by Standard-Vacuum Oil Company).

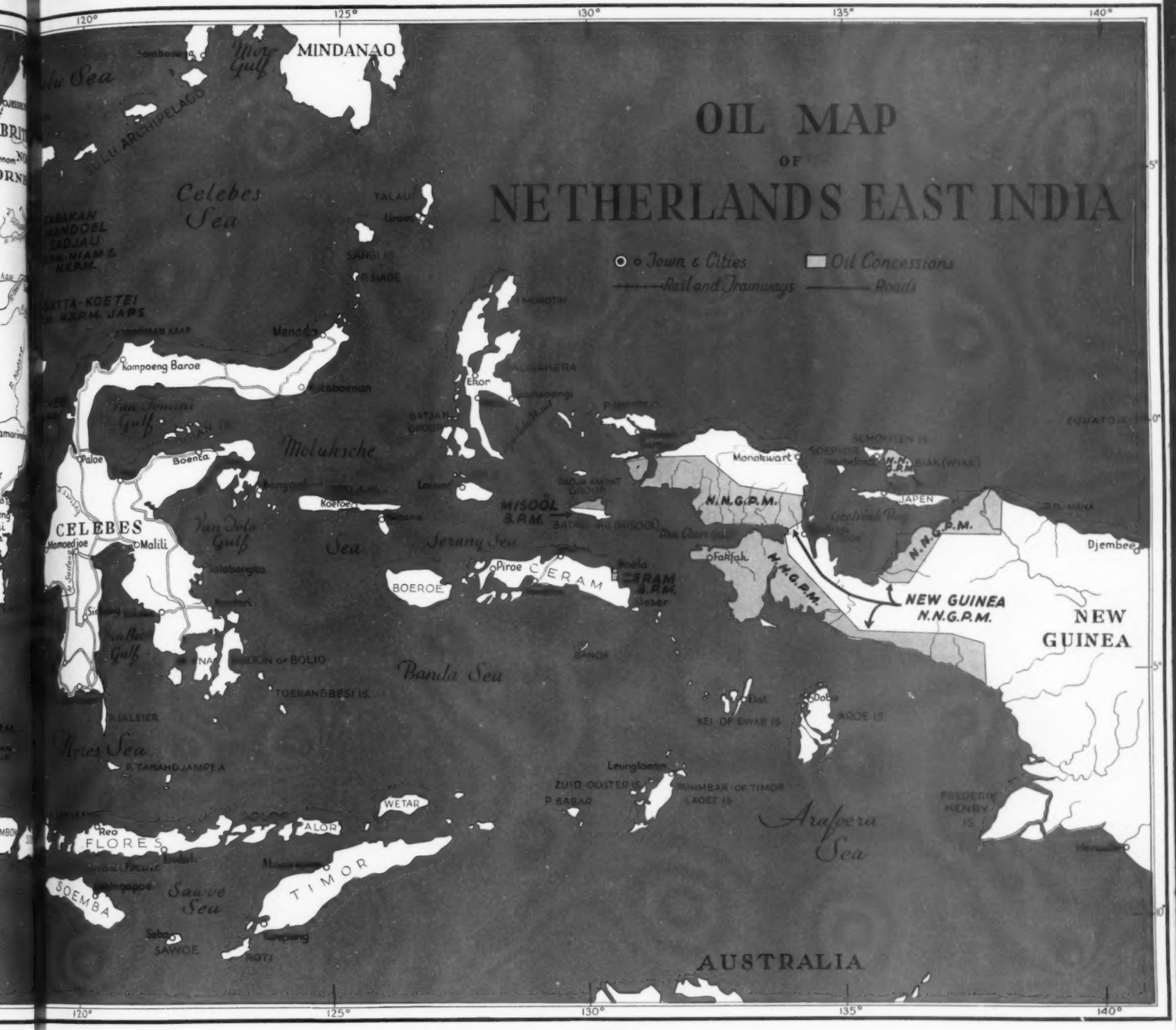
N. P. P. M.—Nederlandsche Pacific Petroleum Maatschappij (controlled by Standard Oil Company of California and The Texas Corporation).

B. P. M.—Bataafsche Petroleum Maatschappij (controlled by the Royal Dutch Shell Group).

N. I. A. M. — Nederlandsch - Indische Aardolie Maatschappij (controlled jointly by the Netherlands East Indian Government and through B. P. M. by the Royal Dutch Shell Group).

N. N. G. P. M.—Nederlandsche Nieuw Guinee Petroleum Maatschappij (controlled 40 percent by Royal Dutch Shell through B. P. M., 40 percent by Standard - Vacuum through N. K. P. M., and 20 percent by California Standard and The Texas Company through N. P. P. M.).

There are in addition a number of smaller companies but their operations are on a relatively restricted scale. Actually therefore, the bulk of the work is being done by three



large companies, Standard Vacuum, Royal Dutch Shell and the combination of Standard of California and The Texas Company. These companies draw on their tremendous resources to devote the most modern equipment to the task of developing existing fields and to the more exacting task of discovering new fields in a country where transportation alone presents almost insuperable difficulties. Diesel-powered drilling units, electrical coring, gun perforating, and squeeze cementing are common practice. Slim hole drilling is used to acquire geological information. Air-mapping has played an unusually important part in the exploration work, particularly in New Guinea where the three companies are working over a huge area of jungles, swamps and mountains.

Starting from the west of this great archipelago which extends from the Indian to the Pacific oceans and covers an area more than twice as big as the State of Texas, important producing fields controlled by B. P. M. (Shell) including Perlak, Rantau, Serangdjaja and Pangkalan Soesoe,—are located in a relatively narrow strip extending along the Northeast coast of Sumatra for a distance of 70 miles, in the area to the northwest of Medan, the largest city in North Sumatra. The B. P. M. is actively exploring this coastal strip, one large exploration block,—the Deli Block,—being located in the southeastern part of this trend, surrounding the city of Medan, and another large exploration block,—the Tjoenda Block,—being located in the northwestern part of this trend. Moreover the Djambo Aje exploitation block, which adjoins the Tjoenda exploration block on the northeast, is also getting considerable exploration attention.

A series of folds of secondary importance, lying between the above mentioned coastal belt and the mountain backbone of Sumatra, is being explored by the N.K.P.M. (Standard-Vacuum) in the older Pase and Rajeu exploitation blocks and in the more recent Bireuen and Penaron exploration blocks. Only one small field has been developed to date on this inner belt, namely, at Oeloe Djawa, on the Pasé block.

Between the well established producing fields in North and South Sumatra there is an extensive coastal plain, much of which is swampy, stretching for a distance of approximately 500 miles through Central Sumatra, east of the mountain backbone. In this area the N. K. P. M. (Standard-Vacuum) holds two exploitation blocks and four exploration blocks and the N. P. P. M. (Cal-Tex) holds

(Continued on Page 38)

Foreign Oil Legion

S. D. BECHEL and H. C. PRICE sailed from New York, March 15th, aboard the Santa Rosa en route for Caracas and Puerto La Cruz, Venezuela, in the interest of the Compania Constructora Bechtel-Price, S. A. It will be remembered that this company was engaged in work on the construction of the 100 mile, 16 in. crude oil pipeline which runs from Oficina to Puerto La Cruz and belongs to Mene Grande Oil Co.

Morgan Walker, Standard Oil Co. of New Jersey, sailing from New York on the Manhattan for a four months' trip through Italy to Hungary.

Frederick J. Wolfe, chairman and managing director of Anglo-American Oil Co., Ltd., on board the Manhattan just before sailing from New York for London. Mr. Wolfe is pictured with his wife who came to the boat to see him off.

Left to right below, Ricardo Simpson, advisor to the Chilean Electric Company; Carlos Vial, of Saa & Vial, construction engineers; Hector Marchant, vice-president of Chilean Petroleum Company; and Manuel Zanartu, general manager of Chilean Petroleum Company—as they arrived from Chile aboard the Chilean liner Anconcagua in New York on March 25th. The group will go to California to study American refining and production methods.

Left, above, Joseph T. Deane operating manage and right, W. R. Lindenblatt, engineer, of the California Texas Oil Company en route to Bahrein Island from New York. They sailed March 23rd on the Manhattan and expect to be away for three years.

Maurice E. Nicklin

MAURICE E. NICKLIN has been appointed manager of the export division of Oil Well Supply Company succeeding Charles L. Lockett, Jr., who recently resigned. Mr. Nicklin will make his headquarters in New York. In his former position as export manager of Waukesha Motor Company, he travelled extensively in South America and in Europe.

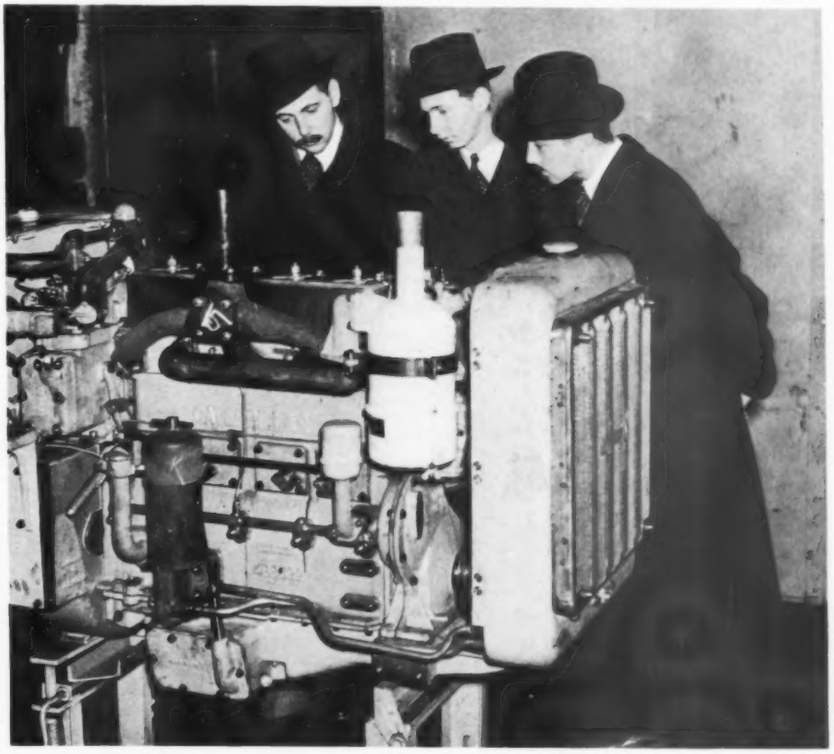
JOHN BAIRD, president of the New York Chapter of the Nomads and regent of the national organization, formation of which was described in the March issue of WORLD PETROLEUM, presided over the second meeting of the group held at Jack Dempsey's restaurant in New York on Monday, April 1st. The officers who attended the meeting and one of their guests are pictured at the top of the opposite page: from left to right, E. H. Trammell, secretary-treasurer, the guest Frank Champion, vice president of the

Houston chapter of Nomads, John Baird, president, Val. Wittich, assistant sergeant at arms, and I. Frank Brown, sergeant at arms. The meeting was attended by sixteen members and the dinner that followed was attended by an additional thirty-eight guests.

COL. J. FRANK DRAKE, president of the Gulf Oil Corporation, on behalf of W. L. MELLON, Chairman of the Board, the Directors, and the Corporation, extended congratulations to some ten thousand Gulf employees who have completed ten years of service with the company. Gold pins set with precious stones and service certificates were awarded to these employees at district gatherings held throughout the United States.

Col. J. Frank Drake

Left to right below, Count Francis Trauttmannsdorff, Archdukes Felix and Otto of the Austrian House of Hapsburg, inspect a tractor engine in the plant of the Caterpillar Tractor Company at Peoria, Illinois. The two archdukes, with their secretary, Count Francis, were en route to visit the farm lands of Iowa. They expect to return to their home in Paris shortly.



WORLD OIL

All figures furnished direct to WORLD PETROLEUM by governments, except where otherwise specified. Figures in

U. S. BARRELS

	Mar. 1939	Apr. 1939	May 1939	June 1939	July 1939	Aug. 1939	Sept. 1939	Oct. 1939	Nov. 1939	Dec. 1939	Jan. 1940	Preliminary Figures Feb. 1940
United States	106,768,000	105,510,000	110,541,000	104,607,000	110,937,000	80,865,000	108,168,000	114,197,800	111,887,000	114,808,500	113,140,700	108,238,900
Soviet Union[4]	18,000,000	18,100,000	18,500,000	18,700,000	18,200,000	18,100,000	18,000,000	18,406,932[1]	17,813,160[1]	18,406,932[1]	18,406,932[1]	17,251,721
Venezuela	15,646,415	16,980,646	17,676,580	16,430,625	18,015,249	18,743,714	18,652,354	17,434,307	16,681,881	16,050,535	14,798,667	16,050,137
Iran[5]	6,992,667	7,237,755	6,801,192	6,341,652	6,637,503[1]	6,637,503	6,423,390[1]	6,637,503[1]	6,423,390[1]	6,637,503[1]	6,637,503[1]	6,227,896
Netherland India: Sumatra	3,393,286	3,401,503	3,602,543	3,498,094	3,557,020	3,550,123	3,502,437	3,600,371	3,427,490	3,629,655	3,472,786	3,317,040
Borneo	1,144,647	1,113,474	1,173,509	1,154,341	1,156,942	1,111,810	865,693	995,207	1,068,349	1,086,713	1,093,743	1,033,906
Java[9]	550,097	509,355	530,273	514,565	565,181	559,096	511,355	556,658	549,926	633,136	561,064	521,831
Ceram	67,440	82,914	89,975	77,305	73,962	71,767	68,065	64,292	62,340	60,550	59,215	66,281
Roumania	3,973,053	3,743,881	3,840,413	3,684,366	3,902,208	3,945,625	3,795,308	3,842,567	3,743,041	3,842,154	3,786,908	3,595,899
Mexico[13]	3,118,021	3,140,120	2,945,000	3,100,000	3,245,000	3,700,000[1]	4,050,000	4,500,000	3,700,000	3,500,000	3,348,682	3,050,000
Iraq	2,699,272	2,608,235	2,663,827	2,721,992	2,807,402	2,615,129[1]	2,530,770[1]	2,615,129[1]	2,530,770[1]	2,615,129[1]	2,615,129[1]	2,461,722
Colombia	1,818,765	1,826,928	1,899,735	1,851,716	1,798,271	1,950,966	1,894,941	1,860,620	1,918,891	1,871,594	1,924,655	1,767,840
Trinidad	1,630,789	1,569,298	1,645,040	1,575,321	1,620,564	1,636,645[1]	1,583,850[1]	1,636,645[1]	1,583,850[1]	1,636,645[1]	1,636,645[1]	1,529,800
Argentine	1,554,957	1,507,159	1,559,568	1,533,250	1,508,738	1,495,806	1,542,755	1,632,997	1,621,927	1,691,123	1,751,910	1,496,197
Peru[8]	1,210,288	1,151,193	1,078,426	1,051,265	1,100,000[1]	1,100,000[1]	1,116,810[1]	1,154,037[1]	1,116,810[1]	1,154,037[1]	1,154,037[1]	1,071,860
Bahrein[14]	658,822	629,336	626,009	628,812	671,892	698,714	647,595	571,673	563,985	645,575[1]	645,575[1]	603,722
Burma[7]	698,103	581,633	696,936	665 942	650,828	696,317	685,756	647,311[1]	626,430[1]	647,311[1]	647,311[1]	609,221
Canada[3]	385,273	559,368	713,947	821,308	899,169	795,844	720,866	816,257	731,209	502,920	665,632	633,211
Brunei[9]	492,374	466,328	486,815	464,271	490,318	488,777[1]	473,010[1]	488,777[1]	473,010[1]	488,777[1]	488,777[1]	456,575
Great Germany: Old Reich[16]	396,181	373,126	407,028	373,510	391,098	381,114[1]	368,820[1]	381,114[1]	368,820[1]	381,114[1]	381,114[1]	360,381
Ostmark[15]	43,293	54,375	64,840	74,726	85,131	58,869[1]	56,970[1]	58,869[1]	56,970[1]	58,869[1]	58,869[1]	57,072
Slovakia and Moravia	10,000	9,000	10,000	9,000	11,000	11,000[1]	9,810[1]	10,137[1]	9,810[1]	10,137[1]	10,137[1]	9,651
Poland	333,618	326,436[1]	333,800[1]	318,000[1]	330,000[1]	330,000[1]	320,370[1]	331,049[1]	320,370[1]	331,049[1]	331,049[1]	310,152
Japan[12]	222,386	218,612	221,129	221,128	222,072	210,105	222,513	223,016	224,494	223,960[A]	225,308[1]	210,801
British India[11]	236,042	105,477	127,700	137,070	175,932	200,036	212,322	188,666[1]	182,580[1]	188,666[1]	188,666[1]	171,301
Ecuador	181,938	175,896	193,353	193,710	206,868	204,115	193,720	193,382	196,808	205,138	204,509	188,851
Saudi Arabia	215,270	234,742	281,325	302,932	342,558	429,104	538,136	512,590	313,757	437,020	491,663	323,616
Sarawak[13]	115,990	110,982	112,572	104,224	107,961	112,716[1]	109,080[1]	112,716[1]	109,080[1]	112,716[1]	112,716[1]	104,951
Egypt[13]	330,445	328,376	368,081	425,231	436,519	440,678	362,880	420,519	434,174	385,795[1]	385,733[1]	367,691
Italian Empire: Albania[18]	125,440	244,576	81,839	79,931	140,025	89,000[1]	114,540[1]	118,358[1]	114,540[1]	118,358[1]	118,358[1]	112,239
Italy	8,324	7,792	7,253	7,181	6,843	7,600[1]	7,736[1]	7,750[1]	7,500[1]	7,750[1]	7,750[1]	7,220
France	42,000[1]	41,000[1]	42,000[1]	41,000[1]	42,000[1]	42,000[1]	42,653[1]	42,470[1]	41,160[1]	42,532[1]	42,532[1]	39,817
Hungary	67,261[1]	67,000[1]	70,000[1]	67,000[1]	70,000[1]	70,000[1]	65,210[1]	65,317[1]	63,210[1]	65,317[1]	65,317[1]	62,330
Bolivia	8,700[1]	8,500[1]	8,700[1]	8,500[1]	8,700[1]	8,700[1]	7,893[1]	8,556[1]	8,280[1]	8,556[1]	8,556[1]	7,972
Other Countries[17]	50,000	48,000	50,000	48,00	50,700	50,700	50,000	49,073	47,490	49,073	49,073	45,840
WORLD TOTAL	173,159,157	173,073,016	179,405,408	171,832,968	180,464,654	151,408,573	177,915,608	184,382,665	179,022,502	182,534,839	179,517,221	172,412,650

[A] Estimated official sources.
[1] Estimated W. P.
[2] Includes natural gasoline (naphtha) production.
[3] International Petroleum Company and Lobitos Oilfields, Ltd., figures combined.
[4] Russian Saghalin included with U.S.S.R.
[5] Anglo-Iranian Oil Company, Ltd., figures revised —fuel oil returned to the ground has been deducted.
[6] Bahrein Petroleum Company, Ltd., figures.
[7] Does not include Assam or Punjab, which are listed together under British India.
[8] British Malayan Petroleum Company, Ltd., figures.
[9] Includes Madura.

Daily Averages in Barrels

	Jan.—Feb. 1940	Jan.—Feb. 1939
United States	3,690,493	3,321,440
Soviet Union	594,310	584,712
Venezuela	514,146	532,014
Iran	214,423	228,814
Netherland India: Sumatra	113,163	103,372
Borneo	35,461	35,873
Java	18,049	17,605
Ceram	2,093	1,770
Roumania	123,046	128,345
Mexico	106,644	75,085
Iraq	84,614	74,068
Colombia	61,541	55,888
Trinidad	52,774	53,417
Argentine	54,135	55,932
Peru	37,098	39,916
Bahrein	20,821	21,335
Burma	20,942	20,000
Canada	21,647	15,047
Brunei	15,755	16,272
Great Germany: Old Reich	12,358	14,391
Ostmark	1,932	1,360
Slovakia and Moravia	327	331
Poland	1,086	10,440
Japan	7,268	7,438
British India	5,999	5,543
Ecuador	6,542	6,223
Saudi Arabia	13,584	5,535
Sarawak	3,627	3,758
Egypt	12,545	10,340
Italian Empire: Albania	3,843	1,464
Italy	250	246
France	1,372	1,390
Hungary	2,127	1,340
Bolivia	276	268
Other Countries	1,583	1,440
WORLD TOTAL	5,865,488	5,450,752

Official Crude Oil Production Figures for 1933 to 1939 (Revised) in Barrels

	1939	1938	1937	1936	1935	1934	1933
United States	1,264,256,000	1,214,355,000	1,279,160,000	1,098,516,000	996,596,000	908,065,000	905,656,000
Soviet Union	216,727,024	206,192,000	201,856,661	199,635,921	184,008,033	175,635,783	155,596,429
Venezuela	205,956,300	188,429,050	187,675,477	155,270,840	148,809,057	136,098,681	117,113,946
Iran	78,151,332	78,320,840	78,109,001	62,977,950	57,520,488	57,902,092	54,440,073
Netherland India: Sumatra	41,405,392	34,538,128	33,451,511	30,469,428	28,004,595	26,336,011	22,345,172
Borneo	13,035,694	12,812,383	12,960,072	13,068,910	13,529,185	14,335,543	15,003,175
Java	6,542,775	6,955,283	7,152,931	3,618,293	3,462,440	3,778,920	3,600,350
Ceram	825,706	607,622	537,436	375,823	311,872	273,698	285,332
Roumania	45,931,846	48,366,000	52,395,725	63,532,846	61,270,072	61,849,306	53,919,700
Mexico	39,428,141	38,505,824	46,455,687	41,027,915	40,240,563	38,171,946	34,000,000
Iraq	30,791,132	32,404,000	30,603,660	29,913,150	27,410,983	7,639,849	1,094,915
Colombia	22,036,613	21,581,588	20,297,543	18,756,110	17,597,655	17,337,900	13,156,125
Trinidad	19,270,256	17,736,176	15,502,989	13,237,030	11,671,224	10,894,363	9,561,333
Argentina	18,613,167	17,076,237	16,354,717	15,457,960	14,297,025	14,021,901	13,690,558
Peru	13,587,906	15,908,279	17,459,112	17,593,069	17,056,555	16,314,381	13,257,310
Bahrein	7,601,167	8,297,998	7,762,264	4,644,635	1,264,807	285,072	31,277
Burma	7,621,707	7,499,498	7,847,553	7,587,718	7,181,113	7,278,859	7,114,231
Canada	7,837,503	6,965,457	2,996,033	1,507,931	1,447,204	1,410,895	1,145,333
Brunei	5,755,164	5,387,214	4,397,038	3,296,938	3,302,905	2,705,350	2,035,650
Great Germany: Old Reich	4,487,491	3,850,044	3,148,300	3,076,858	2,967,438	2,204,402	1,656,602
Ostmark	693,247	370,038	221,266	50,092	44,347	27,965	5,750
Slovakia and Moravia	119,380	132,005	123,474	126,603	136,580	177,797	121,695
Poland	3,898,044	3,828,438	3,799,862	3,869,575	3,901,881	4,011,336	4,174,675
Japan	2,652,930	2,511,184	2,487,841	2,403,072	2,294,878	1,872,837	1,504,402
British India	2,221,406	2,330,209	2,161,653	1,978,329	2,037,810	1,921,863	1,620,810
Ecuador	2,312,118	2,257,278	2,161,436	1,942,467	1,731,785	1,636,619	1,619,992
Saudi Arabia	3,933,904	495,135	64,968	19,777	Nil	Nil	Nil
Sarawak	1,327,327	1,624,882	1,655,565	1,547,882	1,776,593	1,942,591	2,206,853
Egypt	4,541,746	1,561,231	1,163,267	1,262,666	1,255,151	1,527,252	1,653,335
Italian Empire: Albania	1,393,727	437,597	380,292	219,693	41,218	17,500	11,477
Italy	91,330	106,083	112,700	129,653	128,615	162,449	213,333
France	500,815	516,240	507,067	534,063	529,664	700,000	706,500
Hungary	769,092	330,829	13,910	100	Nil	Nil	Nil
Bolivia	100,885	106,620	123,123	104,746	163,295	157,875	111,977
Other Countries	578,036	243,000	70,000	37,100	32,300	64,000	54,100
WORLD TOTAL	2,029,996,303	1,982,639,390	2,041,170,134	1,797,791,150	1,652,023,331	1,516,760,036	1,438,797,445

PRODUCTION

Figures in U. S. barrels of 42 gal.—Conversion ratios used are weighted averages for individual countries

METRIC TONS

	Mar. 1939	Apr. 1939	May 1939	June 1939	July 1939	Aug. 1939	Sept. 1939	Oct. 1939	Nov. 1939	Dec. 1939	Jan. 1940	Preliminary Figures Feb. 1940
United States	14,445,677	14,275,470	14,956,000	14,153,000	15,009,700	10,941,000	14,635,096	15,450,953	15,138,276	15,533,757	15,307,901	14,651,454
Soviet Union[1]	2,469,000	2,480,000	2,536,000	2,590,000	2,500,000	2,480,000	2,300,000	2,508,024[1]	2,427,120[1]	2,508,024[1]	2,508,024[1]	2,360,194
Venezuela	2,323,150	2,521,254	2,624,585	2,439,598	2,674,870	2,783,031	2,769,466	2,586,268	2,476,894	2,383,153	2,197,278	2,382,060
Iran[2]	927,608	960,120	902,208	841,248	880,493[1]	880,493[1]	852,090[1]	880,493[1]	852,090[1]	880,493[1]	880,493[1]	826,152
Netherland India: Sumatra	434,424	435,476	461,214	447,842	455,386	454,503	448,398	460,936	438,803	464,685	444,602	424,647
Borneo	146,543	142,552	150,238	147,784	148,117	142,339	110,830	127,411	136,775	139,126	140,026	131,573
Java[3]	70,426	65,210	67,888	65,877	72,357	71,578	65,466[1]	71,266	70,404	81,057	71,830	66,787
Ceram	8,634	10,615	11,519	9,897	9,469	9,188	8,842	8,231	7,981	7,752	7,581	8,497
Roumania	538,719	507,645	520,734	499,575	529,113	535,000	514,618	521,026	507,531	520,970	513,479	487,578
Mexico[3]	457,859	461,104	432,452	455,212	476,505	543,316	594,713	660,973	543,318	513,950	492,094	447,870
Iraq	360,817	348,648	356,079	363,854	375,271	349,556[1]	338,280[1]	349,556[1]	338,280[1]	349,556[1]	349,556[1]	330,034
Colombia	253,663	254,802	264,956	258,258	247,017	272,101	264,287	257,920	267,627	260,524	268,431	246,094
Trinidad	229,365	220,717	231,370	221,564	227,927	230,206[1]	222,780[1]	230,206[1]	222,780[1]	230,206[1]	230,206[1]	215,151
Argentine	221,503	214,695	222,160	218,411	214,919	213,077	219,765	232,620	231,043	240,900	249,559	213,121
Peru[3]	159,774	151,973	142,367	138,782	146,000[1]	146,000[1]	147,810[1]	152,737[1]	147,810[1]	152,737[1]	152,737[1]	141,810
Bahrein[3]	89,811	85,920	85,353	85,665	91,551	95,348	87,030	78,012	76,963	87,885[1]	87,885[1]	82,186
Burma[3]	96,423	80,336	96,261	91,980	89,893	96,176	94,717	89,404[1]	86,520[1]	89,404[1]	89,404[1]	84,129
Canada[3]	49,029	71,184	90,856	104,518	114,427	101,278	91,736	103,875	93,052	64,001	84,692	80,562
Brunei[3]	65,684	62,209	64,943	61,935	65,410	65,193[1]	63,090[1]	65,193[1]	63,090[1]	65,193[1]	65,193[1]	60,900
Great Germany: Old Reich[14]	56,654	53,357	58,205	53,412	55,927	58,300[1]	53,190[1]	54,963[1]	53,190[1]	54,963[1]	54,963[1]	51,997
Ostmark[15]	6,454	8,106	9,666	11,289	12,691	13,000[1]	9,030[1]	9,331[1]	9,030[1]	9,331[1]	9,331[1]	9,048
Slovakia and Moravia	1,500	1,400	1,500	1,400	1,600	1,600[1]	1,550[1]	1,519[1]	1,470[1]	1,519[1]	1,519[1]	1,421
Poland	44,968	44,000[1]	45,000[1]	41,000[1]	45,000[1]	45,000[1]	42,960[1]	44,392[1]	42,960[1]	44,392[1]	44,392[1]	41,644
Japan[3]	31,631	31,095	31,455	31,454	31,544	31,721	31,651	31,723	31,933	31,857[A]	32,178[1]	30,131
British India[11]	32,602	14,568	17,638	18,932	24,300	27,629	29,326	26,040[1]	25,200[1]	26,040[1]	26,040[1]	23,635
Ecuador	23,986	23,190	25,491	25,539	27,272	26,910	25,540	25,495	25,947	27,045	26,962	24,788
Saudi Arabia	29,161	31,799	38,110	41,037	46,404	58,129	72,899	72,899	42,503	59,201	66,604	43,812
Sarawak[12]	14,823	14,183	14,386	13,329	13,797	14,539[1]	14,070[1]	14,539[1]	14,070[1]	14,539[1]	14,539	13,543
Egypt[13]	47,193	46,897	52,568	60,730	62,342	62,936	51,810	60,057	62,150	55,087[1]	55,335[1]	52,432
Italian Empire: Albania[16]	18,801	36,657	12,266	11,980	20,987	13,000[1]	17,100[1]	17,670[1]	17,100[1]	17,670[1]	17,670[1]	16,762
Italy	1,034	968	901	892	850	950[1]	961[1]	961[1]	930[1]	961[1]	961[1]	899
France	6,000[1]	5,700[1]	6,000[1]	5,700[1]	6,000[1]	6,000[1]	5,760[1]	5,952[1]	5,760[1]	5,952[1]	5,952[1]	5,568
Hungary	9,041[1]	9,000[1]	9,500[1]	9,000[1]	9,500[1]	9,500[1]	8,490[1]	8,773[1]	8,490[1]	8,773[1]	8,773[1]	8,381
Bolivia	1,000[1]	1,000[1]	1,000[1]	1,000[1]	1,000[1]	1,000[1]	960[1]	992[1]	960[1]	992[1]	992[1]	928
Other Countries[17]	7,000[1]	6,700[1]	7,000[1]	6,700[1]	7,100[1]	7,100[1]	7,000[1]	6,975[1]	6,750[1]	6,975[1]	6,975[1]	6,525
WORLD TOTAL	23,679,965	23,678,550	24,547,815	23,528,394	24,694,739	20,786,697	24,201,311	25,217,385	24,474,800	24,938,670	24,514,157	23,572,313

[2] Japanese Saghalin, Taiwan (Formosa) and Hokkaido included with Japan.
[3] Excluding Burma.
[11] Sarawak Oilfields, Ltd., figures.
[12] Anglo-Egyptian Oilfields, Ltd., figures.
[13] Prussia, Thuringia and Baden.
[14] Formerly known as Austria.
[15] Italian imports of Albanian crude oil.
[16] Estimate representing Morocco, Cuba, New Zealand, Barbados, Greece, Algeria, Yugoslavia, Australia, Great Britain, Kuweit and China.
[17] Official Figures—Petroleos Mexicanos.
[A] Estimated Official Sources

Daily Averages in Metric Tons

	Jan. 1940	Feb. 1939
United States	499,322	449,621
Soviet Union	81,136	80,203
Venezuela	76,322	78,644
Iran	28,444	30,339
Netherland Ind a Sumatra	14,487	13,875
Borneo	4,526	4,781
Java	2,310	2,363
Ceram	267	237
Roumania	16,684	17,522
Mexico	15,666	11,153
Iraq	11,326	9,931
Colombia	8,575	7,837
Trinidad	7,422	7,508
Argentine	7,711	7,950
Peru	4,909	5,298
Bahrein	2,835	2,906
Burma	2,892	2,696
Canada	2,754	1,884
Brunei	2,101	2,134
Great Germany: Old Reich	1,782	1,613
Ostmark	306	203
Slovakia and Moravia	49	52
Poland	1,432	1,373
Japan	1,038	1,051
British India	827	763
Ecuador	862	882
Saudi Arabia	1,840	750
Sarawak	469	493
Egypt	1,796	1,482
Italian Empire: Albania	573	215
Italy	31	31
France	192	193
Hungary	285	186
Bolivia	32	34
Other Countries	225	220
WORLD TOTAL	801,441	746,423

Official Crude Oil Production Figures for 1933 to 1939 (Revised) in Metric Tons

	1939	1938	1937	1936	1935	1934	1933
United States	171,053,443	164,346,325	172,822,797	148,707,864	134,912,143	122,913,903	122,601,191
Soviet Union	29,530,168	28,859,000	27,867,025‡	27,384,900	25,241,100	24,092,700	21,330,100
Venezuela	30,580,000	27,845,286	27,733,926	22,945,299	21,990,373	20,112,115	17,293,193
Iran	10,367,112	10,358,495	10,330,480	8,329,289	7,607,500	7,657,970	7,200,093
Netherland India: Sumatra	5,320,319	4,662,836	4,490,137	4,114,710	3,759,006	3,535,035	2,999,352
Borneo	1,675,810	1,719,783	1,739,607	1,773,545	1,815,998	1,924,234	2,013,849
Java	840,957	933,595	960,125	499,097	464,757	516 320	483,331
Ceram	106,144	81,560	72.139	50,446	41,862	36 738	38,300
Roumania	6,228,047	6,603,000	7,153,000	8,704,000	8,394,000	8,473,355	7,387,000
Mexico	5,794,215	5,716,423	6,896,657	6,090,842	5,973,955	5,666,857	5,049,109
Iraq	4,115,845	4,345,000	4,126,185	4,079,066	3,724,231	1,048,108	147,943
Colombia	3,067,568	3,007,935	2,844,251	2,614,092	2,452,635	2,416,432	1,833,606
Trinidad	2,710,515	2,472,943	2,181,676	1,862,796	1,642,446	1,533,122	1,345,532
Argentina	2,651,448	2,432,857	2,330,063	2,202,304	2,036,903	1,997,706	1,950,499
Peru	1,798,557	9,099,885	2,313,691	2,331,454	2,260,903	2,161,990	1,756,867
Bahrein	1,034,982	1,130,734	1,058,557	635,555	173,072	39,008	4,293
Burma	1,052,708	1,039,960	1,083,391	1,047,593	991,456	1,004,951	982,233
Canada	997,391	879,921	378.478	190,495	182,820	178,233	144,686
Brunei	767,700	707,123	576,545	470,991	471,842	386,478	290,808
Great Germany: Old Reich	647,337	552,074	453,451	444,600	427,400	317,500	238,600
Ostmark	109,904	63,468	33,010	7,473	6,616	4,172	860
Slovakia and Moravia	18,103	19,282	18,036	18,665	19,946	25,971	17,776
Poland	522,874	504,678	501,301	510,630	614,760	529,200	550,670
Japan	379,161	356,328	341,040	341,976	326,580	266,520	212,667
British India	306,765	322,125	298,450	273,137	281,072	265,341	224,879
Ecuador	306,824	319,877	306,326	275,293	245,434	231,947	229,578
Saudi Arabia	536,366	66,683	8,070	2,447	Nil	Nil	Nil
Sarawak	171,322	200,126	217,085	221,126	253,799	277,513	315,259
Egypt	648,780	223,058	166,298	177,491	176,436	214,671	232,437
Italian Empire: Albania	208,279	65,313	56,760	32,760	6,152	2,500	1,707
Italy	11,346	13,178	14,000	16,106	15,977	20,180	26,526
France	70,224	72,106	71,008	74,788	74,172	98,025	110,120
Hungary	103,364	42,798	13,910	13	Nil	Nil	Nil
Bolivia	11,904	13,262	15,487	13,197	20,540	19,858	14,085
Other Countries	82,300	34,080	10,000	5,300	4,600	9,100	7,700
WORLD TOTAL	283,827,782	279,111,097	279,482,962	246,449,340	226,610,486	207,971,753	197,034,849

NETHERLAND INDIA EXPLORATION

(Continued from page 33)

the large Rokan exploration block. Both companies are active with geophysical and exploration drilling campaigns.

In the Djambi residency of South Sumatra the N. I. A. M.,—which is controlled by the N. E. I. Government and the B. P. M. jointly,—holds a very large exploitation block which contains a large number of anticlines. Four well-established fields are on production in the southern part of the block, and small amounts of production have recently been listed from the Meroeo Senami and Toeba Obi structures, in the more northern part of the block. A systematic exploration drilling program designed to determine the prospects of wildcat structures is in progress.

In the Palembang residency of South Sumatra there is a mixture of old, relatively young, and very recent fields, and in the areas closely adjacent to these fields the B. P. M. and N. K. P. M. hold a number of exploration blocks on which active drilling campaigns are being carried out. Particular mention might be made in this connection of the Moesi, Ogan, Radja and North Benakat exploration blocks of the N. K. P. M. and of the Kikim exploration block of the B. P. M.

Total production from Sumatra for 1939 was 5,320,000 tons.

JAVA

The greater part of West Java is controlled by the B. P. M. and at the present time that company is the only active explorer there. Thus far no commercial fields have been reported in West Java, but an active exploration drilling program continues.

The East Java fields on the other hand are among the oldest in Netherland India and there have been a few recent discoveries, notably Kawengan. The B. P. M. and N. K. P. M. both hold exploitation and exploration blocks in East Java and both companies are carrying out active exploration programs. Off the northeast coast of Java lies the island of Madoera where the B. P. M. holds large exploration areas covering the military reserved zone around the edges of the Island. Java produced a total of 840,900 metric tons during 1939.

BORNEO

Activities in Northeast Borneo center around the Tarakan field of the B. P. M., on the island of the same name. Between Tarakan island and the mainland of Borneo,—i.e., to the west and north,—there are a number of large delta islands lying in the mouths of the Semoebekoeng and Sesajap rivers. In this area geophysical surveys have been carried out and exploration drilling is in progress, including, in addition to the activities of the B. P. M.,—drilling by the N. K.-P. M. on old mining concessions on Mandoel island, 25 miles north of Tarakan. On the Borneo mainland, 50 miles southeast of Tarakan, the B. P. M. is active on their Sadjau exploitation block.

In the Samarinda—Balikpapan district of East Borneo, where the important Sanga Sanga and Sambodja fields are located, the B. P. M. is the only operator at present.

The B. P. M. has recently obtained a large exploration block covering the delta islands at the mouth of the Samarinda river, directly east of Sanga Sanga.

To the southwest of the Samarinda — Balikpapan district the Meratoes Mountains constitute a geological barrier separating the East Borneo development from an extensive coastal and river swamp basin in Sout Borneo, lying to the north of the town o Bandjermasin.

In the northeastern part of this majo geological province the B. P. M. is ver active on their large Amoentai explorati block and recently that company obtaine an additional exploration block covering large area immediately contiguous to th Amoentai block on the north.

In the western part of the South Borne basin the N. K. P. M. holds the larg Kahajan exploration block on which consid erable exploratory drilling has been done Immediately to the north of this block th N. K. P. M. recently obtained the Kapoea exploration concession to serve as an exten sion of the Kahajan development.

During 1939 Borneo produced 1,675,80 metric tons of crude oil.

CERAM

Moving almost a thousand miles east o Borneo past the Celebes, one finds the island of Ceram where 106,144 metric tons of crude were produced in 1939. Activities in Ceram are limited to the operations of the B. P. M. in developing the Boela district on the northeast point of the island.

NEW GUINEA

Still further east lies New Guinea divided into Dutch, British and Australian. Here Shell, Standard-Vacuum and Cal-Tex have combined to carry on one of the world's most extensive exploration campaigns. In the Netherlands part of New Guinea, which is the western half of the island, the N. N. G. P. M. originally held exploration concessions covering 25,000,000 acres. This immense area has now been reduced to 20,000,000 acres on the basis of exploration results to date. Further exploratory drilling is now in progress on three locations in the so-called Vogelkop sector of New Guinea, north of Mac Cluer Bay.

WORLD PETROLEUM ABSTRACTS

Summaries of the Most Important Articles as Published in the Oil Press of the World Dealing With Technical and Economic Aspects of the Petroleum Industry. Edited by Dr. O. W. Willcox

DRILLING

The Eykometer, a New Device for Measuring Yield Point of Clay Suspensions and Muds—A. George Stern in BUREAU OF MINES REPORT OF INVESTIGATIONS NO. 3495.

An oil-well drilling mud serves several functions, many of which depend on the "gel" characteristics of the mud. Among the more important functions are: (a) To plaster the sides of the hole to prevent caving of the walls; (b) to prevent the loss of the circulating fluid out of the hole by seepage; (c) to carry sand and cuttings out of the hole to the surface as they are formed by the rotary drill; and (d) when circulation of the fluid stops for shut-down or other unavoidable cause, to hold the cuttings in suspension by the setting up of the gel, thereby avoiding the difficulties that result when these cuttings are allowed to fall through the fluid and pack at the bottom of the hole.

Proposals have been made to measure this "gel" property by allowing a cylinder, sheet, or other shape of metal to sink through the mud and observe the depth to which it sinks. This and other methods have been tried, but shortcomings have prevented their wide adoption. The only device that is widely used is the Stormer viscosimeter, but reproducibility of operations with this instrument is poor.

Now the Bureau of Mines has produced a new instrument that at least gives better promise than any heretofore proposed. It consists of a rubber balloon or bag, in the mouth of which is fixed a transparent tube made of a Du Pont plastic called Lucite. The tube carries a millimeter scale. The outfit is immersed in a container filled

with water. The rubber bag and tube are filled with the mud to be tested; then the level of the outside water is raised by means of a movable leveling bulb. The yield point of the mud is noted as the differential hydrostatic head required for moving a selected visible particle in the gelled mud (a grain of anthracite coal, for instance) through a vertical distance of one millimeter.

From the published results it appears that reproducibility of results by the Eykometer method is within plus or minus 3 per cent, while comparative results with the Stormer method rarely give better than plus or minus 5 per cent.

The muds tested were various concentrations of California, Wyoming, Volclay and Italian bentonites, Hector clay, and Texas natural drilling mud "as is".

Effect of Varying Well-Bore Diameters in California Reservoirs—Ernest K. Parks, before AMERICAN PETROLEUM INSTITUTE, Chicago, November, 1939.

Whether large-diameter wells or small-diameter wells are the most profitable in the end is a question on which there is considerable diversity of opinion. In an effort to obtain a factual basis for drawing a conclusion data was acquired through a questionnaire directed to California operators.

The results of the investigation disclose a strong economic urge to reduce the diameter of oil-well casings. While technologically the smaller size involves a reduction in the potential rate of producing the well, this reduction is discounted on the basis of present overproduction, under which a small well will produce the allowable with as much ease as a large one. In other respects the advantages of the small hole may not be entirely real. While whatever effect small size has on cumulative production is discounted because of the application of the present-worth factor, there is a definite conviction on the part of some operators that smaller-sized wells do not result in lower drilling costs, and that future difficulties with production equipment in small-bore wells has not yet been evaluated. Some of the operators were unable to furnish data on the effect of hole size on production performance which indicates that unknown factors remain to be evaluated and that further concerted study of the problem is highly desirable. In this connection the opinion of J. E. Brantly is quoted:

"It is now, and has long been, my opinion that the California operators drill over-sized holes and set casing and tubing that is unnecessarily large. I base this opinion on my knowledge of common practice in the Mid-Continent and in foreign fields. It would seem to me that a proper consideration of this subject would probably lead to a substantial reduction in the drilling cost of oil and gas wells in California."

OPERATING

Effect of Reducing Pump Submergence—M. L. Mayfield, in OIL WEEKLY, Vol. 96 (1939), No. 2, pp. 17-20; 22; 24; 26; 28; 30.

This writer points out that it makes a good deal of difference where an oil-well pump is placed in relation to the "working level", which is defined as the height to which the level of the column of fluid in the well is drawn down in normal operation. The matter is of importance in such districts as the west side of the East Texas field. The rule in this district is to place the pump perforations opposite the oil formation, whereas the working level may be high up. After a number of tests on different wells the conclusion is reached that the conventional rule is uneconomical. The pump should be placed only a short distance below the working level. If placed near the bottom, a higher initial investment for pumping equipment and a longer time for pay-out will be the result. This initial investment may be decreased by $1,500 to $1,850 as compared with past practice. Of course, the working level will ultimately sink and a larger unit will have to be installed, but the savings accomplished by deferring the cash requirements will more than offset the infrequent additional costs incurred should the larger unit be needed for depletion.

Experience acquired with this method shows that the well is not injured and it seems that there is some retardation of water encroachment. There are some points to be observed. In some cases it seems that plugging off bottom-hole water by the squeeze or semi-squeeze method causes appreciable decreases in sand permeabilities which excludes the possibility of high working levels. Unless sufficient submergence is obtained "gas locking" may occur. The subsurface equipment must be very carefully designed. In any case it is highly essential to make a preliminary test and study of individual wells before installing the equipment.

Full Effect of Water Flooding in Bradford—J. P. O'Connell, in OIL & GAS JOURNAL, Vol. 38 (1939), No. 30, pp. 43-44; 45.

The case history of an approximately 50 acre tract in the Bradford oil field (Penna.) is discussed as an example of what can be expected as the final result of recovery of oil by repressuring with water (flooding) under fair conditions and with the application of the most advanced practice known at present.

Systematic development of the property in question was begun in 1929 and it has now about reached the limit of its economic life as defined by present conditions. The project was based on core analyses from seven wells, which on the average showed the presence of 18,238 bbl. of oil to the acre. The oil-sand thickness was 47.4 feet with a porosity ranging between 4.5 to 17.25 percent; 86 percent of the sand had an average saturation of 44.8 percent. It was figured that the ultimate recovery would be 7,000 bbl. per acre.

During the first four years of flooding the recovery was 268,340.79 bbl. which was 85 per cent of all that was recovered up to May, 1939, when production had declined to 0.27 bbl. per day per well, indicating practical depletion at present prices for Pennsylvania crude oil. The ultimate recovery has now reached approximately 8,000 bbl. per acre, instead of the 7,000 bbl. originally estimated. A total of 3,504,093 bbl. of water was injected into the formation, which gives a ratio of water injected to oil produced of 113 to 11, or a volumetric efficiency of 9 per cent. Water produced with the oil over the whole period is slightly above 5 to 1. Development costs totaled $159,701.18; total cost, including operation, administration and other overhead was $655,080.07, and the gross revenue $660,096.93, leaving a net profit of $5,016.92. The smallness of the profit is partly explained by the fact that the property was purchased in 1929 for $5,000 per acre and the price of Pennsylvania crude oil was then $3.61. Had that price been maintained the profit would have been more than $400,000. Another unfortunate circumstance was that 60 per cent of the production was obtained in 1931-2-3, when the price averaged $1.92.

The amount of unrecoverable or residual oil left in the sand is estimated at 10,238 bbl. per acre, or 56.2 per cent of the original saturation; the residual saturation is thus about 25 per cent, which may be accepted as about the minimum below which recovery by flooding will be impractical.

PIPELINES

Cooperative Problems Involved in Cathodic Protection (of Pipe Lines)—L. F. Scherer, before AMERICAN PETROLEUM INSTITUTE, Chicago, November 1939; 21 pages.

The practice of protecting buried pipe lines from corrosion by making the line the cathode of an electrical circuit has proved its worth and is being generally adopted.

However, the spread of this helpful practice has at length raised some complications in regions where several concerns have their own systems of cathodic protection, which have generally been installed and maintained with little or no attention to the presence of neighboring systems. The result is that the operation of one system may disturb the operation of another.

This interference eventually became acute among the pipe line companies in the area east and southeast of Chicago. This area is highly industrialized and congested. Pipe lines, underground telephone and telegraph cables, utility services, street-car lines, and electrified-railway crossings—with interchanging current and all owned by different interests—presented a difficult problem for solution.

A committee composed of representatives of the involved interests was formed. This committee drafted a test procedure, and conducted a joint survey of all structures. This voluntary organization, through cooperation and discussion of their joint problems, was successful in definitely reducing electrolytic damage in this area. It clearly pointed the way to the need of a permanent organization to deal specifically with the problems involved in electrolytic-mitigation work. Such an organization would be at once a clearing house for essential information and advice in joint involvement, and would serve as a means of disseminating data pertinent to industry.

Through this organization, known as the Mid-Continent Cathodic Protection Association, some helpful cooperation has been obtained to harmonize conflicting interests through cooperation. It is expected that many operators, especially the smaller ones who have no corrosion engineer of their own, will find this Association a helpful source of information and advice which may lead them to adopt this useful means of protecting their properties, and it is hoped to extend this cooperation throughout the industry. The address of Mr. Scherer is the Texas Pipe Line Co., Houston, Texas.

A Comparison of Methods for Estimating the Corrosivity of Soils—K. H. Logan and E. A. Koenig, before AMERICAN PETROLEUM INSTITUTE, Chicago, November, 1939.

In 1937 the Magnolia Pipe Line Company exposed approximately 25 miles of an 8-inch asphalt-coated steel line in southeastern Texas, measured the depth of the deepest three pits on each joint of pipe, estimated the condition of each joint, identified the soils which the line traversed and took samples of each type of soil. These samples have been tested by eight methods for determining soil corrosivity, and the results

compared with the pit depths observed on the joints of pipe nearest the points where the samples were taken. The dispersion of the pit depths associated with each different estimate of the corrosivity of the soils is large, and the conclusion is reached that no test of a single sample of soil reliably will predict the maximum pit depth which may occur near the point where the soil was sampled. However, if a soil survey of the right-of-way of the line is made, the average corrosivity of each kind of soil can be determined with satisfactory precision by several methods. No one test is best for all kinds of soil.

ASPHALT & TAR

Relative Merits of Low and High-Penetration Asphalts in Hot-Mix Construction—Thos. E. Stanton, in RESEARCH SERIES, ASPHALT INSTITUTE, No. 5 (1939), pp. 44-52.

An investigation was made to ascertain the possibility of using softer grades of asphalt than the standard 50-60 penetration without materially changing standard equipment.

The total experience to date, which also includes 22 miles of asphalt concrete using 110 penetration asphalt, indicates that no construction difficulties are involved in the substitution of softer asphalts for the hard 40 to 60 penetration grades. The softer grades permit the use of lower plant temperatures; and all subsequent operations, including mixing, spreading and compaction may be carried out at correspondingly lower temperatures than are required for the harder grades. The possibility of utilizing lower plant temperatures should be advantageous both from the standpoint of the effect on the asphaltic binder and from considerations of economy during construction. The possibility of handling the mixture at lower temperatures is of particular importance during cold weather construction. In the past there is no doubt that many mixtures have been definitely overheated, particularly in winter, in order to facilitate spreading and finishing operations.

In the light of present knowledge, it appears very unlikely that there will be any unsatisfactory developments insofar as stability and resistance to deformation is concerned, even with grades much softer than 100 penetration.

CHEMISTRY

High Octane Aviation Fuel by the Sulfuric-Acid Alkylation Process—Contribution from Anglo-Iranian Oil Co., Humble Oil & Refining Co., Shell Development Co., Standard Oil Development Co. and The Texas Co., presented before AMERICAN PETROLEUM INSTITUTE, Chicago, November, 1939.

The most desirable hydrocarbons as constituents of high grade aviation fuel are the branched-chain or iso-paraffins, of which iso-octane is the most famous. There are several existing processes for producing iso-octane. One is first to polymerize the gaseous lower olefins obtained in cracking operations and then to hydrogenate the polymerized product. Another is to combine the iso-paraffin (isobutane) with the olefin by means of aluminum chloride and other metallic halides; this process avoids the two separate stages of polymerization and hydrogenation.

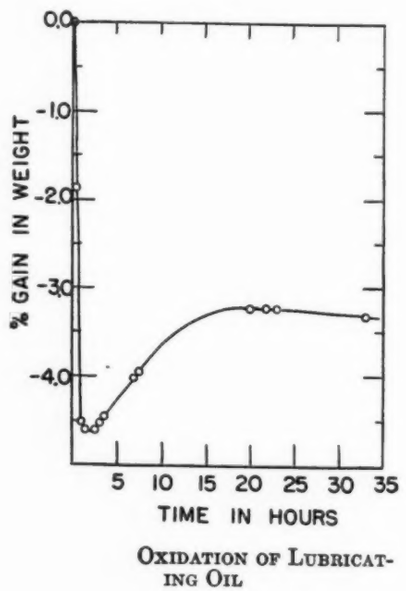
A third process is the sulfuric-acid alkylation process which is the subject of this paper. This process depends on the absorption of olefins in sulfuric acid in the presence of an isoparaffin, preferably iso-butane. These condense to form a product which is a mixture of octanes, the composition of which depends on the charging stock and the operating conditions, but in any case is a fuel of aviation grade.

Sulphuric acid is the only chemical used, although the product may be given a caustic wash to remove possible traces of acid. Strictly speaking, the acid is not consumed in a chemical sense, and a major part of it can be recovered for subsequent operations. The process requires regulation of the strength of the acid and the temperature. The equipment is simple and of standard type. High temperatures are not required, corrosion is negligible and ordinary steel may be used.

One of the basic factors to be considered in the installation of a commercial alkylation plant is the availability of the iso-paraffin, and in most cases this is the factor limiting the capacity of a given plant. With a given supply of iso-paraffin, an approximately equal amount of olefin can be converted by alkylation; and on this basis alkylation offers a very distinct advantage, from a yield and process standpoint, over the two-stage process of polymerization and hydrogenation.

In particular, the yield of 87-octane unleaded gasoline from a C_4 fraction is markedly greater by the alkylation process.

With other olefin feed stocks, alkylation is even more advantageous. Whereas the alkylate from propylene has an octane number of 88, catalytic polymerization of propylene leads to a polymer of relatively low octane number which, on hydrogenation, is degraded further. Catalytic polymerization of C_5 or higher olefins is not commercial.



OXIDATION OF LUBRICATING OIL

Apparatus for the Study of Drying Rates and in the Oxidation of Oils—A. C. Beckel and A. G. Sharp, in INDUSTRIAL ENGINEERING CHEMISTRY, Analytical Edition, vol. 12 (1940), No. 1, pp. 45-47.

The apparatus here described was developed for observing the rate of oxidation of soy bean and other drying oils, but is evidently suitable for studying rates of drying or other change of weight in samples of many other substances, such as sugar products, lubricating oils, etc.

The equipment consists of a long, sensitive wire spring which is suspended in the inner tube of a Liebig condenser and carries a pointer which moves over a millimeter scale. The object of the Liebig condenser is to keep the spring cool. The lower end of the wire extends into the oven or other chamber in which the change of weight is taking place, and suspends the sample so that loss or gain of weight can be read off at any time. By taking several consecutive readings a curve may be traced to show the time rate and trend of the process.

As an example of the application of this apparatus a sample of lubricating oil dispersed on filter paper was oxidized in an atmosphere of dry oxygen at a temperature of 130° C., with the results that have been plotted in the curve shown. After an initial rapid loss in weight due to volatile matter, the sample absorbed 1.44 per cent of oxygen (calculated on the volatile matter-free basis). Because of the importance of oxidation in the "gumming" of lubricants and because of the empirical nature of existing tests, it seems that this apparatus should offer a more rigorous method for comparing the oxidizability of lubricants, as well as providing a method for studying the effect of oxidation inhibitors and various metallic catalysts of these reactions.

From the standpoint of convenience the advantages of the apparatus as a time and labor saver are obvious. Curves with numerous points can be obtained with exceedingly little effort.

Determination of Lead in Ethylized Motor Fuels—Hans Siebeneck, in OEL UND KOHLE, vol. 36 (1940), No. 1, pp. 16-17.

The method recommended by the German Ethyl Corporation is to precipitate the lead as bromide, which is converted into the nitrate, which in turn is converted into the sulfate and weighed as such. This method gives fairly accurate figures, but is time consuming.

The new method is based on the property of lead salts in buffered solutions to become colloidal when treated with sodium sulfide. The procedure therefore is to convert the tetraethyl lead in 100 ml. of gasoline into the nitrate, winding up with 1000 ml. of a water solution of the nitrate; the pH of the solution must not be lower than 5.0. This solution is then tested colorimetrically with the following solutions: (1) 100 grams ammonium chloride and 10 grams of glycocoll made up with water to 500 ml.; (2) 1 gram sodium sulfide in 100 ml. of water; (3) a standard lead solution containing 0.1 mg. of Pb. in 1 ml. The color comparison may be made in any suitable colorimeter. Numerous test analysis show results in close agreement with the gravimetric method while requiring only a fourth of the time.

New Catalytic Syntheses of Hydrocarbons.—V. N. Ipatieff, in MONITEUR PETROLE ROUMAIN, vol. 40 (1939), No. 22, pp. 1433-1438.

This is a lecture delivered before the Paris Sorbonne. After reviewing generally the chemical mechanism of alkylation as it is understood in the petroleum industry the discussion turns on the polymerization of olefins and particularly of isobutene.

In polymerizing isobutene in the presence of phosphoric acid at 30 deg. C. only two compounds are obtained: diisobutene and triisobutene; in this reaction the yield of the dimer is much greater than if sulfuric acid or chloride of zinc are used as the catalyzers. Hydrogenation of diisobutene under pressure in the presence of nickel oxide easily gives isooctane.

If the catalysis of isobutene is effected at 130 deg. C. the product contains three dimers and four trimers. The polymerization of normal butene is analogous to that of isobutene except that the minimum temperature of reaction is somewhat higher.

It is also possible to have mixed or cross polymerizations; for example, cross polymerization of normal butene can be effected with isobutene or with propene. In this connection it is worthy of note that these cross polymerizations take place at a temperature 50 deg. C. lower than that required to polymerize the different olefins singly. Thus, under comparable conditions and in the presence of solid phosphoric acid catalyzer, a temperature of 175 deg. C. is necessary to polymerize normal butene, but the cross polymerization of isobutene occurs at 120 deg. C. In general, this reaction can be extended to include a large number of olefins.

PHYSICS

Temperature as Affecting Oil Well Drilling and Production—Michael J. Halbouty before AMERICAN INSTITUTE OF PHYSICS, New York, November, 1939.

This paper is a general summary of the effects of temperature in operations having to do with the production of petroleum.

Temperature is of interest in drilling operations for several reasons. The least important of these is the effect of temperature variations on mud weight; naturally, when high temperatures prevail in deep wells, the column of mud fluid will be lighter, although the difference of weight between the freezing and the boiling points of water is only 4 percent.

Variations in temperature make it difficult to control the viscosity of a mud fluid; at high temperatures (above 140 deg. F.) chemical mud thinners are less effective and their actions are shorter-lived. Then again some muds are more viscous at high than at low temperatures, all of which confronts the mud engineer with individual problems.

A serious effect of high temperature on mud is to increase the thickness of the cake on the walls of the hole and to increase the amount of water passing from the mud into porous formations. High temperature, by increasing the solubility of certain mineral constituents of the mud, has a flocculating effect which results in poorer wall-building properties.

Some experts are of the opinion that high temperatures (over 350 deg. F.) will tend to soften rock and core bits. However, the author is of the opinion that in spite of the cooling effect of the mud fluid, the friction of bits that are drilling a hard formation under a load of 6,000 to 8,000 lbs. will produce a temperature much greater than 350 deg. F., and that the resulting softening will account for drilling less than 10 feet in extreme cases. It is not considered that temperatures of 350 deg. F. or more, which will hardly be encountered until depths of 15,000 to 20,000 feet are reached, will have any appreciable effects on the strengths of rotary drill pipe and tooljoints.

High well temperatures used to cause trouble in cementing with quick setting cements, but cements that are pumpable for two hours at 212 deg. F. are now available. Well temperatures are further of interest to petroleum engineers in that wells may be logged with electrical temperature instruments, which affords a means of locating gas, oil and water flows.

On the producing side temperature has a great deal to do with convenient operation. Low well temperatures, which may be caused by the vaporization of dissolved gas, may cause clogging by separation of paraffin or tar. The best remedy is to melt off the paraffin by a steam coil or jet, or better by the use of bottom hole chokes in high pressure gas wells. On the other hand production from some "distillate" wells is greatly promoted by cold, which is created by reducing the temperature of recycled gas to —15 deg. F.

Underground temperatures vary a good deal from one region to another. A special study of these regional temperature gradients is now being made on a comprehensive scale by the American Petroleum Institute.

Viscosity-Pressure Characteristics of Lubricating Oils—B. W. Thomas, W. R. Ham and R. B. Dow, in INDUSTRIAL ENGINEERING CHEMISTRY, Vol. 31 (1939), No. 10 pp. 1267-1270.

Previous work by the authors at Pennsylvania State College showed that the viscosity coefficient of lubricating oils may be one thing at low pressures, and quite another under high pressure. They also found that the viscosity coefficient of the lubricating oil is highly dependent on the nature of the crude oil from which it has been derived. Thus, the pressure coefficient of a Pennsylvania oil is regarded as much smaller than that of an oil which has been refined from a Mid-Continent or a Coastal crude. However, this conclusion seemed questionable, since it is known that the process of refining has an influence on the character of the product.

In order to prove their point, which is that oils of higher paraffin content have lower pressure coefficients of viscosity, they took a Pennsylvania neutral oil and solvent-refined it with acetone, and determined the viscosities of the neutral oil, the extract and the raffinate. The results showed that the raffinate had the lowest and the extract the highest pressure coefficients of viscosity. This appears to clinch the theory that paraffinic character is associated with low viscosity coefficient, and that the higher coefficients of Mid-Continent and Coastal oils are due to their greater content ot naphthenic and aromatic compounds. In this work the extract from the Pennsylvania oil behaved like a typical coastal oil.

Viscosity Determination of Sub-Surface Samples of Crude Oil—Paul G. Exline and H. J. EnDean, before AMERICAN PETROLEUM INSTITUTE, Chicago, November, 1939.

An important factor controlling the movement of reservoir fluid to the well bore is its viscosity. It is easy enough to determine the viscosity of a sample after it has been brought to the surface, but it does not necessarily follow that such a viscosity figure will represent the bottom-hole character of the fluid; for one reason, an oil may lose some of its dissolved gas, or suffer some contamination on its way to the top.

It is true that methods are known for securing samples of sub-surface fluids which will differ by a negligible amount from the fluid in its original state, but a difficulty arises in testing the sample thus obtained, because it has to be transfered into the viscosimeter and thus incurs a chance of alteration of its physical condition. The authors get around this difficulty with an apparatus of their invention. With this instrument they can measure sub-surface viscosities over a temperature range of 80 deg. to 200 deg. F. and a pressure range from atmospheric to 4000 lbs. per square inch.

From examples given of experimental tests, pressures of the order of 4,000 lbs. per square inch at 100 deg. F. practically double the viscosity over what it was at atmospheric pressure. At 175 deg. F. the difference in viscosity due to pressure is less, but is still considerable.

New "Thermofor" Kiln and Clay-regeneration Processes for Maintaining Decolorizing Clays at High Efficiencies—I. P. Simpson and J. W. Payne, before AMERICAN PETROLEUM INSTITUTE, Chicago, November, 1939.

Conventional burning methods for regenerating percolation filter clays result in rapid loss in decolorizing efficiency of the clays. Clays commonly are reduced to about 50 percent, or less, efficiency after 5 to 10 burns.

A new kiln, called the "Thermofor kiln," is described which is capable of maintaining clays at about fresh clay efficiency after repeated regenerations. This kiln embodies features of temperature control and heat transfer which prevent the clays from reaching excessive temperatures. Clays which have been regenerated 16 times in a commercial unit of this type have been maintained at about 100 percent efficiency. This kiln is well suited also for regenerating clays by a method termed as "carbonization," whereby clays are obtained which show 150 to 300 percent efficiency for filtering solvent-refined oils.

The "carbonization" referred to, by which the decolorizing power of the clay is increased 150 to 300 percent, is obtained by controlled oxidation of the tarry materials adhering to the clay in such a manner that the tar is not entirely consumed, but a residue is left in a sufficiently active form to have a decolorizing power of its own.

The efficiency of the new process in conserving the original decolorizing properties of the clay depends on a novel form of construction of the kiln. Instead of the rotary furnace or the multiple hearth furnace commonly used the Thermofor kiln takes the form of a stationary chamber containing vertical heat transfer tubes through which a liquid heat-transfer medium flows, which may be molten metal or salt. The interior of the chamber is provided with a honeycombed structure for efficient transfer of heat to the clay which is descending through the tubes. Good control of the temperature of the operation is thus assured. Practically no outside fuel is required, as the apparatus provides its own heat from the combustion of the carbonaceous matter absorbed by the clay in the oil filters. The patent rights are controlled by the Socony-Vacuum Oil Co.

Catalytic Reforming for the Production of Aviation Gasoline—A. G. Peterkin, J. R. Bates and H. P. Broom, before AMERICAN PETROLEUM INSTITUTE, Chicago, November, 1939.

This paper contains a general description of the Houdry process of making aviation-base gasoline. In this process the charge, which may be either a gasoline with a final boiling point of from 400 deg. to 500 deg. F. or a naptha boiling between 250 deg. and 500 deg. F. is pumped through a still where it is vaporized and heated to 850 deg. F. From the still the vapors pass through catalyst cases and then a fractionating tower where the products: aviation gasoline, naphtha, gas oil, and gas are separated. During catalysis some carbon is separated and slows down the action, but the activity of the catalyst is restored by burning off

the carbon by sending a current of hot air through the cases.

As to the economics of the process, it is stated that a new 8500-bbl.-per-day unit costs approximately $1,225,000 within the battery limits, excluding royalty, but this cost may be reduced if existing heating and fractionating equipment can be used. Operating costs are about the same as for a similar thermal operation. Depreciation charges are somewhat higher, in proportion to the larger capital investment. However, considering the quality of the products, the cost per unit of product is believed to be highly favorable as compared to thermal reforming. The unit can be used for cracking gas oils without change of catalyst.

An important advantage of the process is that from ordinary gasolines or naphthas there is produced a large yield (up to 60 percent) of aviation-base fuel which is raised by tetraethyl lead to aviation grade without use of blending agents such as isoctane. Or, motor fuel may be produced from naphthas in yield of from 83 to 94 percent, which will require from 0 to 1.5 ml. of tetraethyl lead to give an ASTM octane number of 75. From gas oils 80-octane fuel is produced on a once-through operation in yield of 35 to 40 percent.

Catalytic Desulfurization to Improve Aviation Blending Naphthas—Walter A. Schulze and R. C. Alden, before AMERICAN PETROLEUM INSTITUTE, Chicago, November, 1939; six pages.

Experimental investigation has shown that the tetraethyl-lead response of aviation gasolines consisting of blends of iso-octane base and straight-run naphtha either of refinery or natural-gasoline origin may be improved markedly by removal of the sulfur compounds from the naphtha. Practically complete desulfurization has been obtained by treatment of the naphtha vapors over bauxite catalyst at temperatures of 700 to 750 deg. F.

Inasmuch as the desulfurized blends have greater lead response, the minimum percentage of iso-octane required in high-octane gasoline may be reduced appreciably. It is possible, therefore, to increase the production of high-octane gasoline without a corresponding increase in iso-octane base. If desired, the hydrocarbon composition of the blend may be left unchanged, and a higher-octane gasoline be produced as a result of the improved lead response.

With special reference to New Mexico (Hobbs) and Borger gasolines it is noted that the bauxite catalyst decomposes the sulfur compounds into hydrogen sulfide, and there is complete removal of mercaptans, monosulfides and disulfides; and as in these low-boiling natural gasolines very little cyclic sulfur is present, it is possible to produce practically sulfur-free stocks.

Even naphthas of 60 octane number treated by this process come into consideration as blending stocks in the manufacture of high octane gasolines, due to their high lead susceptibility.

Survey of Fuel Consumption at Refineries in 1938—G. R. Hopkins in BUREAU OF MINES REPORT OF INVESTIGATIONS NO. 3485 (published December, 1939); 6 pages.

Apparent progress in fuel economy at petroleum refineries, as measured by the average amount of heat units required to refine a barrel of crude oil, received a set-back in 1938, when the average rose to 567,000 B.t.u., compared with 562,000 B.t.u. in 1937.

The primary factor in the rise in average heat requirements per barrel of crude oil refined in 1938 was the decline in total runs to stills. Invariably the average requirement increases when crude runs to stills decline, and vice versa. In other words, annual gains in fuel efficiency at refineries are masked by the degree to which the capacity is utilized. Additional crude runs give lower average heat requirements in two ways—first, because they are made with the expenditure of comparatively small amounts of auxiliary heat, and, second, because the additional runs generally represent simple topping operations. In 1938 crude runs to stills declined 1.6 percent (from 1,183,440,000 barrels in 1937 to 1,165,015,000 barrels in 1938), but the total heat consumption declined only 0.4 percent, or from 663,866 billion B.t.u. in 1937 to 660,956 billion in 1938.

A primary factor influencing heat requirements is the degree to which products are finished for the markets. Products from topping plants require the expenditure of comparatively little heat, but "complete" plants, which make all the common products, if present in the crude, use much more heat per barrel. After classifying straight-run gasoline and the three fuel oils, kerosene, distillate, and residual, as easily refined products and the balance as requiring more operating steps to produce, the data for 1937 and 1938 indicate that the aggregate yield of the "complex" products, including cracked gasoline, increased about 1 percent in 1938. This might explain part of the rise in the average heat requirement per barrel.

Although the ups and downs in crude runs obscure all other factors, there has been a steady improvement in firing efficiency since this series was begun in 1925. Important in this progress were the increased use of heat exchangers, the development of combination units, and the trend from solid to gaseous fuels.

Carbon Test not Closely Related to Performance—W. T. Nelson, in OIL & GAS JOURNAL, Vol. 39 (1940), No. 35, pp. 48, 51.

After making a compilation of data from various sources the conclusion is reached that the Conradson carbon residue test has little value as an indicator that a given engine oil will or will not give rise to trouble with carbon deposits when used in automotive engines. This seems to depend on the nature of the carbon residue left by the oil when it is decomposed by heat, and oils differ in this respect. A tightly adhering deposit may damage the engine mechanism, whereas loose deposits that can easily be removed from the engine walls by moving parts or by the eroding action of gases may give little trouble. What a part this difference in the nature of the carbon may play is indicated by some extensive heavy-duty road tests, wherein it was found that a naphthenic base oil of relatively high carbon-residue content caused less trouble with engine deposits and the engines required far less cleaning than when using paraffin base oils. These results were confirmed in a qualitative way by laboratory engine tests. Acting on this hint several naphthenic oils are being marketed for the express purpose of maintaining a clean engine, and even for the removal of already existing deposits. All of which seems to show that carbon deposition and carbon residue found by test are hardly correlated, except in those special instances in which oils of the same base (treated in a similar manner) are compared and in special services such as the enrichment of artificial gas by the use of gas oil.

Perhaps the carbon test of the future will be one that differentiates the characters of carbon deposits.

Service and Life of Non-Ferrous Tubes in Petroleum Refining—E. S. Dixon, in A. S. T. M. BULLETIN, No. 102 (January, 1940), pp. 21-26.

This paper describes the experience of The Texas Company as regards the service and life of various types of condenser tubes in petroleum refining.

In the Port Arthur refinery of the Texas Company, records show 220,000 tubes in shell-and-tube type of heat-exchange equipment. Approximately 20,000 of these tubes were installed new during the year 1938, and the other 200,000 tubes were in service prior to that time. Of the 200,000 tubes, 56,000 were replaced during the year 1938—a yearly replacement of 28 percent. The tubes used are mostly non-ferrous (brass) and are usually ¾ in. in diameter, 16-gage wall and of various lengths, commonly 10 to 12 ft.

At this refinery the cooling water is often brackish and hot (90 deg. F.); its quality varies with the rainfall, and the degree of corrosion fluctuates with the water quality. Brass tubes, such as Muntz metal and admirality, fail because of dezincification, sometimes in a few months. Red brass fails from water pitting, and from corrosion by acid and sulfides in the distillate. Cracking of admirality tubes has become more common, for some still unexplained reasons. Recently proposed anti-cracking constituents such as arsenic, antimony and phosphorus have yet to make good in practice. Much the same may be said of brass-clad steel. The Texas Company has tested most of the many alloys for tubes on the market, some of which proved to be without value, and some others show promise, particularly an alloy of 70 percent of copper with 30 percent of nickel, which to date has shown excellent results with no failures; being twice as costly as admirality metal it must give twice the life, and indications are that in some locations this will be realized. It is said that refining companies other than The Texas Company have found this alloy to be economical in spite of the high first cost.

Stainless steels have been used in exchangers with poor success, being costly and subject to cracking under stress, and to pitting.

Lately The Texas Company has turned its attention to combating one of the original sources of the trouble—the quality of the cooling water. One means is to inhibit the effect of oxygen in the water by the use of a chromate inhibitor; another is to deaerate the water mechanically, a practice which has long been used in steam plants but is something new when applied to large quantities of cold water; a third line is to apply an electrolytic corrosion prevention scheme to the brass tubes of condensers. These attempts show promise, but have not yet continued long enough to warrant definite pronouncements.

USES

Hypoid - Lubricant Requirements for Passenger-Car and Truck Rear Axles—H. R. Wolf, before AMERICAN PETROLEUM INSTITUTE, Chicago, November, 1939.

Lead-soap active-sulfur hypoid lubricants have been distributed widely, and have been used successfully in all makes of passenger-car hypoid-gear rear axles. These lubricants, when properly compounded, are stable under the operating conditions encountered in passenger cars, and afford a maximum factor of safety at high speed. As far as can be determined at the present time, the lead-soap active-sulfur lubricants will con-

Courtesy: (A) Wallace Supplies Mfg. Co., (B) Midwest Piping & Supply Co., (C) Franks Mfg. Co.

THEY'RE PIPING AWAY THE TWIST & SAG

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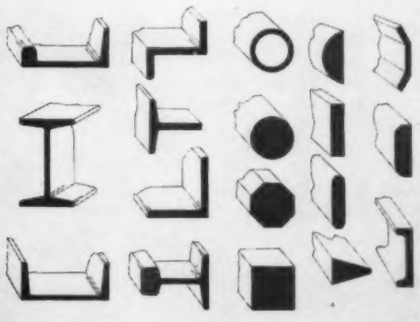
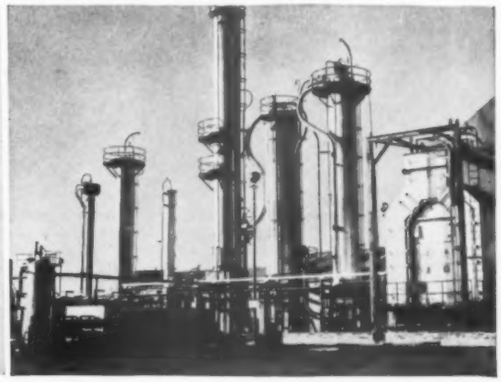


REFINING PROGRESS. New Dubbscracking unit put into operation recently at Wilmington, Calif., by Fletcher Oil Co., Inc. Construction by Fluor Corp., Ltd. Practically 100% welded with Lincoln *"Shield-Arc"* Welders and "Fleetweld" Electrodes.



tinue to be entirely satisfactory for all passenger-car hypoid-gear rear axles. The lead-soap active-sulfur lubricants are, however, unsatisfactory for use in heavy-duty truck hypoid-gear axles.

Conversely, some of the so-called mild types of hypoid lubricants are satisfactory in heavy-duty-truck hypoid-gear rear axles and in passenger-car hypoid-gear rear axles at low or moderate speeds but fail to prevent scoring or scuffing of the ring-gear and pinion tooth surfaces in passenger-car service at high speed.

The problem of differentiating between passenger-car service and heavy-duty-truck service demands a prompt extension of the original educational program so that the owner, operator, dealer, and filling-station attendant will understand and appreciate the factors that affect the lubrication requirements of hypoid gears under these radically different service conditions.

Cylinder Lubrication of High-Speed Diesel Engines as Influenced by Temperature and the Combustion Process—A. I. McDonald and L. A. Blanc, before AMERICAN PETROLEUM INSTITUTE, Chicago, November 1939.

The authors contend that combustion products do little to increase piston deposits so long as the combustion is properly controlled. They present evidence that the formation of such deposits from lubricating oils does occur when the oils are exposed in a thin film to hot blow-by gases consisting almost entirely of air.

They conclude that piston deposits as a cause of engine failure may be reduced by reducing piston temperatures to a sufficient extent, provided that such a reduction is possible and does not carry with it other sources of trouble. The reduction of piston temperatures may be obtained in two ways: (1), by running at reduced load and (2), by controlling the water-jacket temperature. However, it is stated that this work was done with Caterpillar diesel engines and may not be applicable to other types without suitable modifications.

It appears, however, that the engine designer can exercise more control over the performance of the fuel in his engine than the fuel manufacturers can under any circumstances. By this it is not meant to infer that the petroleum industry should let down the bars with respect to quality but, rather, that cooperative effort by both industries should be promoted, so that suitable compromises may be effected between engine design and the various economical and commercial angles to be considered in the refining and marketing of petroleum products for diesel service.

Efficient Burning of Fuel in High-speed Oil Engines, with Particular Reference to a Clean Exhaust—A. T. Wilford, in JOURNAL INSTITUTE PETROLEUM, Vol. 25 (1939), No. 192, pp. 649-656.

The paper deals with the measures taken by a large passenger-transport undertaking to ensure efficient combustion of the fuel used by its fleet of oil-engined vehicles. The incentive is a dual one—viz., that of retaining the goodwill of the traveling public, and at the same time achieving an economy in fuel consumption. Incomplete combustion is visibly evidenced by exhaust smoke, four types of which are recognized; a fifth is attributable to excessive consumption of lubricating oil. The prime necessity for efficient combustion is an engine of satisfactory design using a fuel of suitable ignition quality. The combination will not show the desired result, however, without due attention being paid to cleanliness of the fuel and to careful maintenance of engine and accessories.

Of the five types of Diesel engine smoke, the first to be noted is the dense grayish-white smoke momentarily produced in the case of indirect-injection engines when starting from cold. The exhaust will present a blackish haze, more or less dense, if the injectors are in poor condition, the direct-injection engine being the more sensitive in this respect. With both types of engines continous heavy black smoke will be emitted if the setting of the fuel-pump is such as to permit an excess of fuel being injected; the excess-injection point or "smoke limit" is more definite in the case of the indirect-injection engine. The fourth type of smoke attributable to incomplete combustion is really a special case of the third, and may appear as a black puff when the vehicle is taking off from a point. It is due to momentary over-injection, and can be eliminated by correct adjustment of the low-speed injection-stop on the fuel-pump. Excessive consumption of lubricating oil results in the production of a continuous grey smoke, and to avoid any possibility of complaints arising from this cause, it is the Board's practice to keep individual records of lubricating-oil consumption, so that engines may be removed for overhaul before the smoke-point is reached.

Service Tests with Lubricants for High-Speed Oil Engines—A. T. Wilford, in JOURNAL INSTITUTE PETROLEUM, Vol. 25 (1939), No. 191, pp. 606, 622.

An account is given of certain lubricating-oil tests carried out by the London Passenger Transport Board during the past seven years, covering a period of intensive development and in the application of oil engines to passenger vehicles.

Results of tests with solvent refined oils are summarized. It was established that in comparison with previously used lubricants these oils increased engine mileage by 11 percent, reduced oil consumption by nearly 7 percent, reduced cylinder wear by 13.5 percent, and decreased engine failures due to seizures and bearings by 60 percent. This oil has been adopted despite its much higher cost, it being estimated that there will be a net yearly economy of a few thousand pounds. Experience to date indicates that engines are in a cleaner condition internally than was previously the case, and although "lacquering" has been observed, no trouble attributable to it has been encountered.

Diesel Fuel Characteristics Influencing Engine Output—A. J. Blackwood and G. H. Cloud, in JOURNAL INSTITUTE PETROLEUM, Vol. 25 (1939), No. 192, pp. 684-694.

It appears to be generally recognized that the small high-speed diesel engine, the rapid development of which has been one of the outstanding engineering accomplishments of the past decade, still lacks the ability to digest the broad variety of fuels on which its slow-speed predecessors seemed to thrive.

It happens not infrequently that engines are built and then experimentally tested on fuels available at or near the engine manufacturer's plant. The engines may perform satisfactorily on the fuel used. Later, when placed in the customer's hands in different parts of the world, a multitude of troubles often develop due to the wide differences in the various fuel sold for the engine.

In an effort to assist engine builders, fuel-supply men and the men who have to operate these small high speed Diesels the author has sought to identify the factors that underly the problem of power output and economy. Neglecting such matters as cold starting, smoking odor and engine deposits he arrives at the following conclusions:

Fuel viscosity *per se* is not a major factor in the power performance of high-speed diesel engines except in instances where worn injection equipment might make it undesirable to use a low viscosity product.

Assuming complete combustion, fuel volatility affects fuel economy only as it is related to heating value and ignition quality. Heating value, in terms of B.T.U. per gallon, may be closely estimated from gravity.

For most present-day engines having fixed injection timing, ignition quality is a major factor in determining economy in the upper speed ranges. At the lower engine speeds, heat content as measured by B.T.U. per gallon, or as estimated from gravity, is the most important consideration in economy.

The principal diesel-fuel characteristics—viscosity, mid-boiling point, gravity, hydrogen content, heating value (B.T.U. per gallon), and cetane number—are very closely related. If any two of these are known for a given fuel, the others can be closely estimated from a chart which accompanies the paper.

SUBSTITUTES

Lubricating Oil from Tar Oil by Selective Solvation—M. Marder, in OEL UND KOHLE, Vol. 15 (1939), No. 33, p. 649.

Lubricating oil and Diesel fuel has been produced in Germany from the tar oils obtained in the low temperature carbonization of brown coal by an acid alkali refining process. The product is far from satisfactory, due to the presence of undesirable constitutents.

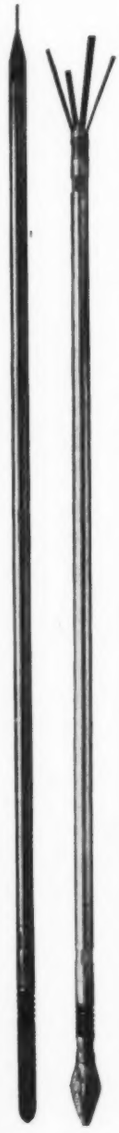
Lately the yield of lubricants and Diesel fuels from these tars has been increased and the quality greatly improved by a selective solvent process. The best results are obtained when the product obtained by solvent-refining is further treated with small quantities of a condensing agent such as aluminum chloride; after the mixture has been allowed to react for a suitable time it acquires a lubricity that answers all the requirements of a good lubricant. If it is further subjected to a vacuum distillation there is a further improvement in the coking test and the viscosity temperature relation. In general the properties of this lube distillate correspond to those of the average commercial lubricant obtained from naphthene base crude petroleums.

ECONOMICS

Economics of Well Spacing—Ionel R. Gardescu, in OIL WEEKLY, vol. 96 (1940), No. 9, pp. 21-22; 24, 26, 28, 30.

In this paper the author attacks the opinion held by many oil engineers and executives who believe that wide spacing of wells means more profit. The point is of importance because engineers and operators testify before official bodies that a density of one well to 20 acres will be sufficient to prevent waste, while experts for the lease and royalty owners testify to the contrary. The fact is that those who advocate a 20-acre-per-

CONTROLLED VERTICAL DRILLING IS *THIS*



HERE is a chart of the course of a typical controlled vertical well. Note that the entire course of the well is within very close limits of a vertical line, and that the angles are low.

Controlled vertical drilling is the practice of USING the information supplied by accurate vertical angle records, taken at close intervals, to direct the course of the bit *straight down*. This results in greater drilling speed because, when the hole is vertical, every formation can be drilled with the most efficient combination of drilling weight and rotation speed for fastest penetration. Mechanical trouble and lost time are avoided; operating costs are reduced; the well is a better well during all of its producing life. It is the *modern* method of drilling—and any drilling crew can successfully practice controlled vertical drilling methods with the regular drilling equipment.

The Totco recording instrument (above right) is encased in a fluid tight go-devil while being run through the drill pipe. Two go-devils (A) for running on measuring line, and (B) for drop-in use, are shown.

HOW INCLINATION RECORDS ARE USED TO CONFINE THE COURSE OF THE HOLE TO VERTICAL

A single record taken at any point and considered alone can only serve as a slope-test. In order to practise controlled vertical drilling the driller must be informed as to whether the angle of the hole is increasing, decreasing, or remaining the same. This information is gained by considering two or more records taken at close intervals (50 to 100 feet apart is recommended). If these records show an increasing angle, he immediately changes the drilling weight and speed to reduce the angle while it is small. The drill string acts as a plumb-bob, and tends to return to vertical when it is in tension; the bit, therefore, cuts away toward the *low* side of the hole when drilling weight is reduced, returning the hole toward vertical.

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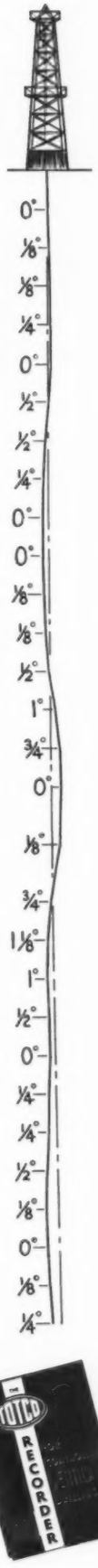

NOT THIS

This is a controlled directional well. Readings of both vertical angles and direction are essential, and special drilling tools, deflecting equipment, and highly skilled supervision are required.

NOT THIS

A crooked well costs more and requires more drilling time than a controlled vertical well. Slope-testing, the practice of taking vertical angle readings just to determine whether or not the contract limit is exceeded, is NOT controlled vertical drilling.

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To be fitted for use in controlled vertical drilling the recorder that supplies the angle readings of the hole must meet these requirements: The record must be ACCURATE, clearly readable to ⅛ of one degree or less, and available to the driller immediately; the instrument must be so designed and constructed that it can be easily and quickly handled by any member of the drilling crew with uniformly good results; timing must be so accurately controlled that records can be taken with a stop on bottom of not more than 45 seconds; the instrument must maintain laboratory accuracy indefinitely and have an operating efficiency of 98% or greater under all circumstances; the equipment must be easily adaptable for all methods of running. The Totco Recorder meets all these requirements; it was developed especially for controlled vertical drilling.

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well spacing often have nothing to show why it should be better than a 15 or a 25-acre-per-well spacing.

As an illustration that spacing may have little or nothing to do with ultimate recovery the case of a Gulf Coast field is cited. One area was drilled to a density of 7.2 acres per well and another area to a density of less than one acre per well. The ultimate recovery of the first area was 1046 bbl. per acre foot; of the other area it was 1089 bbl. per acre foot, a difference of only 4 percent. The period of primary recovery (in each case approx. two thirds) of the first area was 7 years, and of the second area 2 years; the period and rate of secondary recovery of the two areas were the same. Obviously, the shorter period of primary recovery in the second area made a very considerable difference in the overall economics of the two areas, without regard to the fact that the ultimate recoveries were practically the same. The point is that well spacing should be considered from the standpoint of present worth of the property, or the rate at which future earnings are discounted. The prevailing attitude that fewer wells mean more profit may often be unjustified.

BOOKS

Handbook of Geochemical Prospecting—By E. E. Rosaire, published 1939 by SUBTERREX, Houston; paper, 60 pages double column.

This handbook of geochemical prospecting is said to be the first of its kind and is worth reading by persons interested in the not uninteresting problem of finding new oil pools, even though it has much of the character of an advertisement of the services which Subterrex has to offer in the way of surveying and analyzing soils for tell-tale traces of petroleum.

As here set forth, geochemical prospecting for oil is based on the known fact that traces of oil and gas have a tendency to leak out of buried petroleum deposits and find their way upward into the overlying formations and even in the top soil, where, by using refined methods, a chemist can find them. Where these hydrocarbons are found in amounts beyond the ordinary it is a moral certainty that a more or less valuable deposit of petroleum material is underneath. After all, the idea of setting a chemist to looking for oil is not really strange; many oil wells have been drilled on the evidence of visible oil and gas seeps; what the geochemical prospector does is to look for seeps that are not visible to the naked eye.

Although the theory of geochemical prospecting is thus very simple, in practice it requires close attention to details, and the geochemical prospector needs a considerable background of experience and knowledge in order that he may interpret what he finds. These matters are illuminatingly explained in the text.

As the author freely admits, geochemical prospecting is one among many of the tools available to the oil prospector. However, indications are not lacking to forecast for it an increasing usefulness. Practically all visible oil and gas seeps have been preempted and exploited; the geophysists are nearing or at least approaching the time when all possible structural traps will have been discovered, and an oil-hungry world will eventually have to depend on finding the stratigraphic traps that are beyond the ken of the geophysist. It is in

(Continued on page 50)

BOOKS

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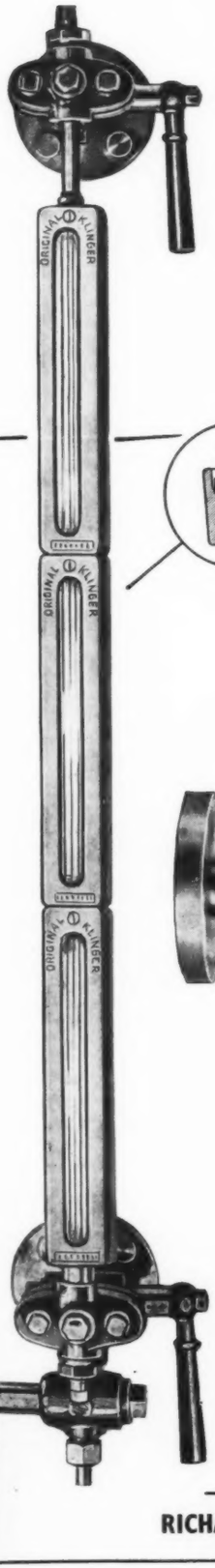

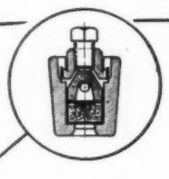

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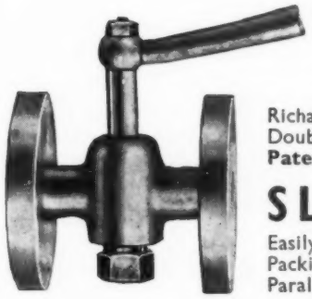

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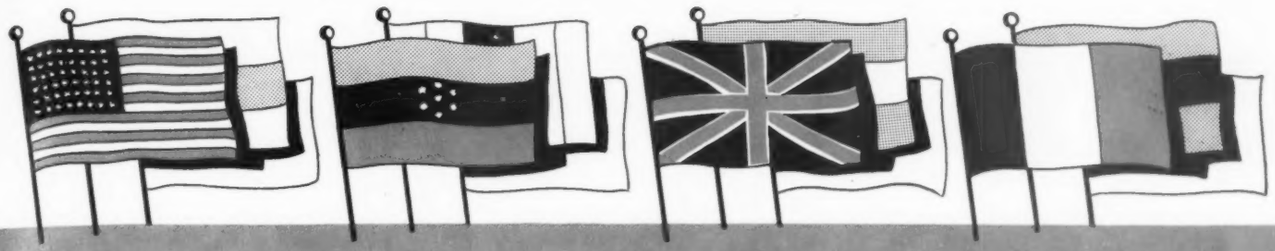

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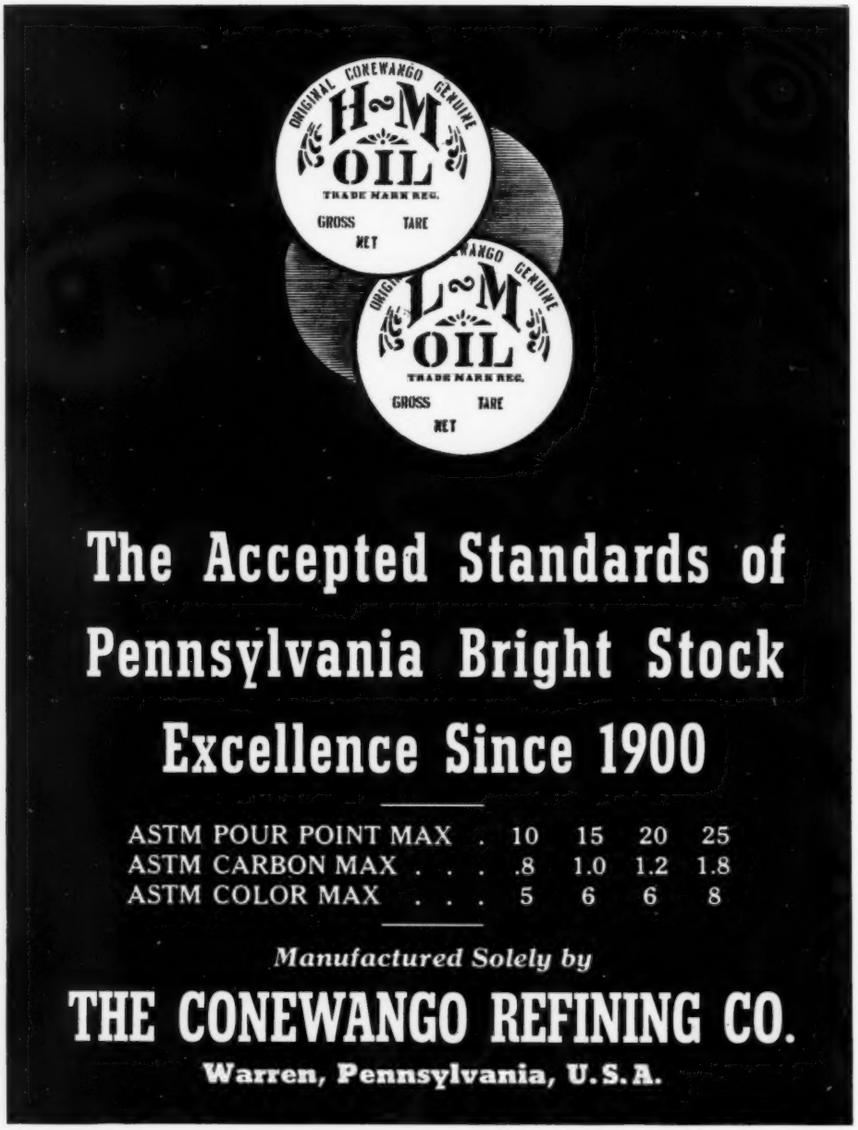

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such work that geochemical prospecting will be called on. Even now the chemical oil prospector is in a position to render valuable help in evaluating and defining marginal and submarginal low relief structural prospects.

Chemical Engineering Catalog, 1939, published by REINHOLD PUBLISHING CORP., New York; 24th edition, 1026 pages, $3.00 (postage free in U. S.).

This valuable work maintains and even improves on its previous reputation as an indispensible aid to all who are concerned with the purchase or use of equipment for any branch of chemical industry, as well as sources of supply of chemicals that may be used in any industrial process. The publishers have added to this edition various tables of technical data and nomographs not generally available, and promise to enlarge this section in future editions.

Practically every firm making any sort of chemical equipment or chemical product in the United States is represented in the indexes. The lists of trade names and sources of raw materials are especially valuable for reference.

Review of the Literature on Laboratory Fractionating Columns, by C. C. Ward; BUREAU OF MINES TECHNICAL PAPER, NO. 600; 36 pages; 10 cents.

Fractional distillation is one of the most important operations in petroleum research laboratories. How to construct, test and operate an experimental still is something worth knowing. Many articles have been published on this subject through the years, and the Bureau of Mines has performed a useful service in compiling the data contained in these scattered publications.

The author has browsed through some 80 separate papers and from them has culled all pertinent hints on how to build and evaluate fractionating equipment for solving all ordinary laboratory distillation problems. A study of the literature has shown that special distillation problems require many types of fractionating equipment. However, for most laboratory studies of petroleum, equipment in which the following requirements are fulfilled will provide satisfactory fractionation:

1. A corrosion-resistant, evenly heated stillpot of proper size for the charge being distilled.
2. An adiabatic column so equipped that efficient contacting between vapor and reflux is attained.
3. A total condenser with a very small hold-up and a variable reflux proportioning device.
4. Adequate control of the operating variables to attain maximum efficiency.

For details the booklet may be consulted with profit.

Looking at the Gasoline of Tomorrow—O. W. Willcox, in WORLD PETROLEUM, vol. 11 (1940), No. 1, pp. 30-32; 51-52.

Reference is made to the two lines of technical advance toward an approach to a utilization of the thermodynamical energy inherent in gasoline. This energy is such that one gallon of an average gasoline can propel an average automobile through a distance of 450 miles on a level road at 20 miles per hour if frictional losses and other wastes of power could be avoided. This ultimate limit of performance is of course unattainable, but important approximations to it have lately become possible through the use of high-octane number gasoline in engines of high compression ratio, and the use of supercharging. In this way it appears commercially feasible to increase the

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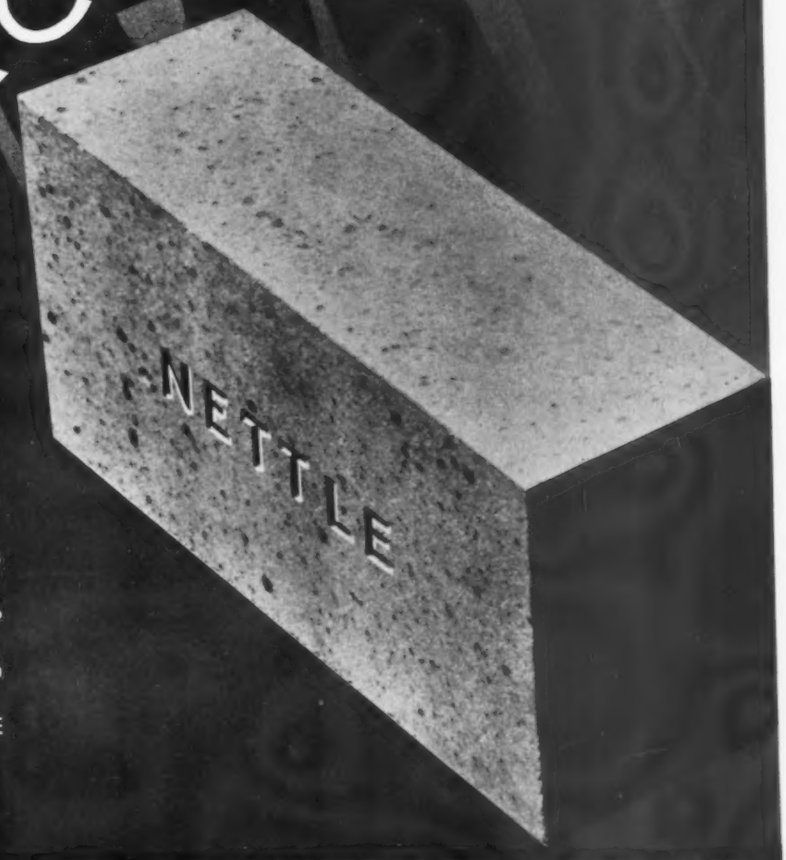

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efficiency of the present-day automobile by 30 to 60 percent, so that the average motorist may travel more miles for the same cost. It is held that the trend toward high compression ratios is certain to accelerate, and that the petroleum refining industry must ultimately be established on the basis of 100-octane gasoline.

Outlook for Future Oil Discovery—A. I. Levorsen, in INDEPENDENT P. A. MONTHLY, Vol. 1 (1940), No. 10, pp. 17-18.

In the matter of future oil discovery in the United States there are two schools of thought. One of these schools has analyzed the available data and from it concludes that we are faced with a shortage of oil supply within a relatively short period of years. Such reasoning is based on the belief that we have fairly well outlined the broad pattern of the geology of our ultimate reserve and that future discoveries will probably fall for the most part within this general framework. They give little value to many of the large areas which are at present non-productive, for the reason that in each of them there have been variable but often many dry holes on most of the known favorable local structures.

The other school analyzes the same data and makes a less pessimistic interpretation.

Considering, for example, the Anadarko basin in western Oklahoma, we find that the drilling has been sporadic; that throughout this vast region no oil has been found except at a few points along the south edge; that but a relatively few test wells have been drilled; and that the surface structure is generally found to be monotonously regular. This apparently unfavorable structure coupled with the fact that geophysical methods have failed to add important new information to the region, has kept operators from doing much exploration work there. It is exceedingly difficult under our present exploration methods and prices to find a spot in this region with sufficient local favorable information to justify the drilling of a wildcat well to the great depth which most persons believe to be necessary. And yet, when viewed as a possible ultimate source of oil reserves, this basin has almost everything in its favor.

Here we find thousands and thousands of feet of sediments, shales, sands and limestones from the Permian to the lower Ordovician which are oil producing formations within relatively short distances north, east, south and west; we find rapid changes in porosity and lithology, a condition which is often extremely favorable to oil accumulation; we find many unconformities extending all over the area, some of which have been found to be closely associated with oil production in the nearby pools at Cement, Oklahoma City, Amarillo, and central Kansas; furthermore, this region lies in the heart of the Mid-Continent district in which almost without exception the surface folding of producing structures, both local and regional, is accentuated, modified, or changed with depth. With our record of experience on every side, it is inconceivable that this region does not contain oil and gas pools of some sort and if considered solely from its geological setting, there is no logical reason for believing it cannot contain pools of a magnitude equal to anything yet found, because the geology is on a grand scale.

Similar considerations apply more or less to other large areas in the Dakotas, Central Nebraska, Northern Mississippi, West Texas and eastern New Mexico. The great East Texas field is a striking example of perhaps many buried wedges that form ideal oil traps and which await discovery by appropriate methods, possible by slim-hole drilling.